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Geological Monograph, No. 2.

GUNNISON,
COLORADO'S BONANZA COUNTY

BY

JOHN K. HALLOWELL,
GEOLOGIST.

PUBLISHED BY THE
COLORADO MUSEUM OF APPLIED GEOLOGY AND MINERALOGY.

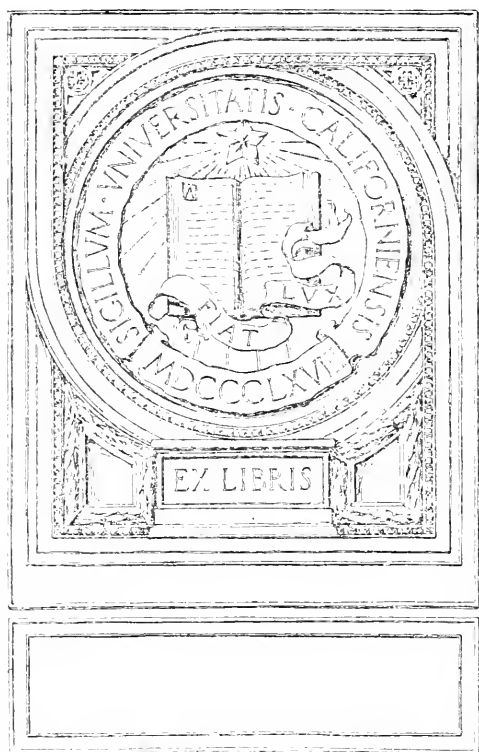
Subscription Edition Distributed 10,000.

Author's Edition 5,000.

Price 50c. Post Paid.

DENVER, COLORADO.
1883

C. J. Kelly, Printer, 406 Holladay Street, Denver, Colo.



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PREFACE.

No excuse or apology is considered to be in order for the appearance of the following pages before my readers. It is something that was found to be needed, the object being to give real and practical information regarding one of the richest sections of Colorado, a territory about which much has been said through the papers and by rumor during the last three years, but until the appearance of the following, there did not seem to be sufficient actual knowledge of this described section shown by any writer.

The appearance of the work in two editions simultaneously, is owing to the manner in which means was raised for its publication, and is as follows: Before leaving Gunnison, in the fall of 1882, I was approached to know if I could not embody the information I had gained in some shape that would do the county good, and asked what I would do. It resulted in the following proposition, that my time and expenses for five months' work, my ten years' experience in geological work, and the time required to prepare the manuscript for a pamphlet would be my contribution, if the residents of Gunnison County would raise the money to print and distribute free, 10,000 copies of the books. I to mail 8,000 copies throughout the United States, the other 2,000 copies to go to the subscribers, pro-rated according to the individual sums paid, and they to send such copies, personally, where they thought the most good would be done.

This proposition appeared to meet with more than favor every where, and I felt encouraged to complete my work; but, when the time came to require the cash, I found from various causes that I must, to make a success, go to the additional expense and time of visiting all parts of the county and solicit these subscriptions myself. This I shrank from, and I can frankly say, that were I able, this part would never have been asked for, as I would cheerfully pay and give the whole myself rather than take the time, and meet what I did, but I am not cowardly and was not going to back out on the last round, even if it did require a part from me that should not have been mine.

To have this work accomplish all of the good possible, it needed to be distributed before the opening of the Exposition at Denver. This would require prompt and energetic work. Well, I have given that much too, but at the end find I will have to pay several hundred dollars to make the amount of printing and postage good, as I took certain responsibilities myself in order to save time. I find no fault with any one, wishing to believe that all have done all that they could, as I tried to do.

At the last moment I accepted a proposition that will either make the above good, or make me more expense, that is to have

an extra edition of 5,000 copies, printed as an author's edition, and placed on sale at the low price of 50c per copy.

This gives fifty per cent. more books than I agreed to publish, but I hope gives me a small chance to be reimbursed for the extra cash I have had to pay out.

I feel that the reciting of the foregoing facts are due, under all of the circumstances to myself, as from private reports already given, very many thousands of dollars have already been brought into Gunnison County, and that very many more thousands will follow such investments when the knowledge I gave in private reports, is thus made widely public.

To give such information in as practical a method as I could think of, I have tried to make these pages a hand-book of the described territory, so that the reader, if he so desired, could go from mining camp to mining camp, and have recorded facts as I found them, to judge by, and from his own observations as a practical business man realize himself, whether, in any part of Gunnison County, there was an opportunity for a fair profit for him with the legitimate use of capital.

That I think there is, is proved by what I have herein said, that others think there is, is proved already by what has been invested on what I have already reported, and if the ratio should keep up for three years more, Gunnison County will truly be proved to be Colorado's Bonanza County.

To have this proved by the work of one man principally, might be considered glory enough, perhaps it is, but the air is too rare at these altitudes to live upon "glory" alone, hence the strong advertising I give myself, that I may get my share of the branch of mining that I follow for a living, viz: reports, purchases and sales of mining property. Cash from this source means additional work of this kind in future years of my residence in Colorado.

There is one thing in connection with all this, that I sincerely regret, but could not help now, although I do hope to be able to remedy it in the future, by publishing a supplement to this. That is, I could not add Tin Cup and the Taylor Park country to the present work, it was utterly impossible. In five months I traveled over 1,500 miles on foot and on horseback, to accomplish what was done. I thoroughly examined 3,000 square miles, and certainly am not to blame that Gunnison County is so large and so rich.

To amend this as much as possible, I insert here the Tin Cup product, which talks for itself. Within a year I think she will have an outlet to Gunnison City, thus making more of her ore products available.

The following is taken from the *Denver Tribune* of April 16, 1883, and while I cannot say that of my own knowledge, I can verify all that is stated. I am quite confident that it represents

in a compact and clear manner the value of Tin Cup as a mining district, and as before stated hope to be able to prove it personally.

TIN CUP, Colorado, April 10.—About thirty miles east and north of Gunnison City, within Gunnison County, lies the Taylor River basin. This basin is formed by the Continental range to the east, the Taylor range to the north, Elk range to the west and Fossil range or Gold hill range to the south. It is forty miles north and south, with a mean breadth of fifteen miles. The contour of the basin is open and level. Within this basin is the headwaters of Taylor River, quite a large stream of water the year round. Ties and sawlogs can be floated down in the spring. The entire basin is very heavily timbered, except a strip along the river from two to five miles in breadth. The body of the basin is of fine gravel formation. Taylor River proper, Texas and Willow Creeks, unite near the point where Taylor River enters the canon, forming a large stream of water. Seventeen miles west of where Taylor River breaks through the Elk range, running west, Taylor and East Rivers unite and form Gunnison River (near Fisher's). Every part of the several ranges that form the basin are rich in silver, gold, iron, plumbago and lead. The formation of Elk range is principally lime, with porphyry dykes running through it. Within this range (Elk) we have the mining camps of Spring Creek, Italian Mountain, Forrest Hill, Head of Taylor River or Emma. Ashcroft is near the junction of Elk and Taylor ranges, but its present and most accessible inlet and outlet is through Taylor basin. Along the Taylor range we have the camps of Beauman and Telluride. The formation of Taylor range is lime, porphyry and granite. Telluride lies at the junction of Taylor and Continental ranges and extends from this junction south to the interseption of Fossil or Gold Hill range. Just south of Telluride, following the divide for ten or twelve miles, is a broad gold belt, in granite formation. This has very little development, on account of being under a heavy deposit of gravel. But all gulches coming down from it, some eight or ten in number, show up very well in free or placer gold, several of which have been worked, and are paying well. South of this gold belt, still following the range, is Chin's camp, or main district. The gold belt and Chin's camp are both of granite formation. Texas Creek Mining District lies south of Chin's camp. The formation there is granite with lime dykes or ledges. South of this we have the American Mountain District of granite and gneiss formation. This brings us to the Tin Cup Mining District. All of these districts are well timbered, well watered and of easy approach, from the basin by firm gravel wagon roads.

While these camps are all easy to get at from within the basin, they are hardly accessible from the outside. The Cottonwood, Alpine and Pitkin passes all cross a rough and rugged road,

Alpine pass being the best of the three. The most natural and easiest approach is down Taylor River to Gunnison, thirty miles to the nearest part of the basin, and from thirty five to fifty miles to any of the districts herein mentioned. The grade up Taylor River will average from Fisher's, where Taylor and East River unite, to the canon, where Taylor enters the Elk range, or outlet of the park or basin, about 126 feet to the mile, as shown by the grade stakes of the Denver & Rio Grande railway survey. The river makes a canon where it leaves the basin for nearly four miles. Then the canon opens out to considerable breadth on each side of the river. A railroad can easily and cheaply be built up through this canon, with a cost not greater than \$3,500 to \$4,500 per mile, from where the track now lies at Fisher's to within the basin (seventeen miles). The grading is principally gravel work. There is no danger of snow slides and no danger of the river ever "gorging" to interfere with the road bed. Where the river enters the canon (seventeen miles from Fisher's) is the town site of Taylorville, on magnificent placer ground. From Taylorville all the above named mining claims are of easy approach, and for the railroad to reach any of these only a road bed need be thrown up, little or no grading being required. By referring to the accompanying list of mining claims, the revenue to the railroad can be easily seen. It is twenty-eight miles from Taylorville to Gunnison City. Below I give the distances from Taylorville to the different camps within the basin; the population of last season, in which will be doubled this; also the output last season, which was secured by only doing the required assessment for the year, and which output can be increased five to ten fold this year, if these camps have the outlet given them by a railroad. Ashcroft is not within the basin, but her inlet and outlet is through it

FROM	Miles	Population	Daily output in tons	Value of ore per ton oz.	CHARACTER OF ORES.
1. Taylorville to Spring Creek	7½	200 to 300	25 to 20	80	Galena & carbonates
2. Taylorville to Italian Mountain	13	125 to 150	8 to 70	70	Galena
3. Taylorville to Forrest Hill	9	100 to 125	5 to 30	100	Free gold and galena
4. Taylorville to Head of Taylor River	15	180 to 250	10 to 30	100	Galena and chlorides
5. Taylorville to Ashcroft	18	200 to 350	30 to 25	180	Sulphides, carbonates chlorides, galena
6. Taylorville to Beauman	13½	100 to 180	10 to 25	100	Galena
7. Taylorville to Telluride	13½	100 to 125	3 to 35	400	Tellurium
8. Taylorville to Gold Belt	8½	75 to 100	Placer
9. Taylorville to Chin's camp	9	100 to 125	5 to 30	120	Chlorides and galena
10. Taylorville to Texas Creek District	11	125 to 175	8 to 25	200	Galena and sulphides
11. Taylorville to Tin Cup	10	250 to 400	10 to 35	1000	Sulphurets, chlorides, galena and free gold

What a railroad wants to know in projecting a branch or line is, what it will cost and what revenue it will have. The answer here is evident.

A branch line from Fisher's up into this basin would be less than eighteen miles in length with no heavy grades, and a safe and solid road bed all the way, with no blockades in winter from snow. It would enter a country that would demand supplies, at the lowest calculation, for 1,500 to 3,000 miners, and it would have the handling of from 100 to 150 tons of ore per day. If a railroad was built within reach of the ten camps here shown, in less than three months 5,000 persons would be added to their population and the output of ore would rise to from 800 to 1,200 tons per day. Within this basin there is all character of ores—lime, plumbago, iron, lead and copper. The entire basin is covered with good saw-timber and timber for ties, etc. There would be more revenue to a railroad that would build to it, which is within the near reach of both the Denver & Rio Grande railroad and the Denver, South Park & Pacific railroad, than any other line they can build of 100 miles in extent.

I further promise that, if I can get sufficient encouragement to make a special work of the Tin Cup, Taylor Park, Ashcroft and Aspin sections, during the year 1883, and let the results of such examinations be known next winter.

I can only add, that very much work has been done during the past winter and since my personal visits to sections, and in every instance, the results so far surpass anything that the most sanguine could have expected in these few months.

To Mr. John H. McCoy this work is respectfully dedicated, as he is doing more than any other one man for Gunnison City and county, and to him, personally, I owe much for encouragement and aid, to enable me to accomplish what I have done.

Respectfully,

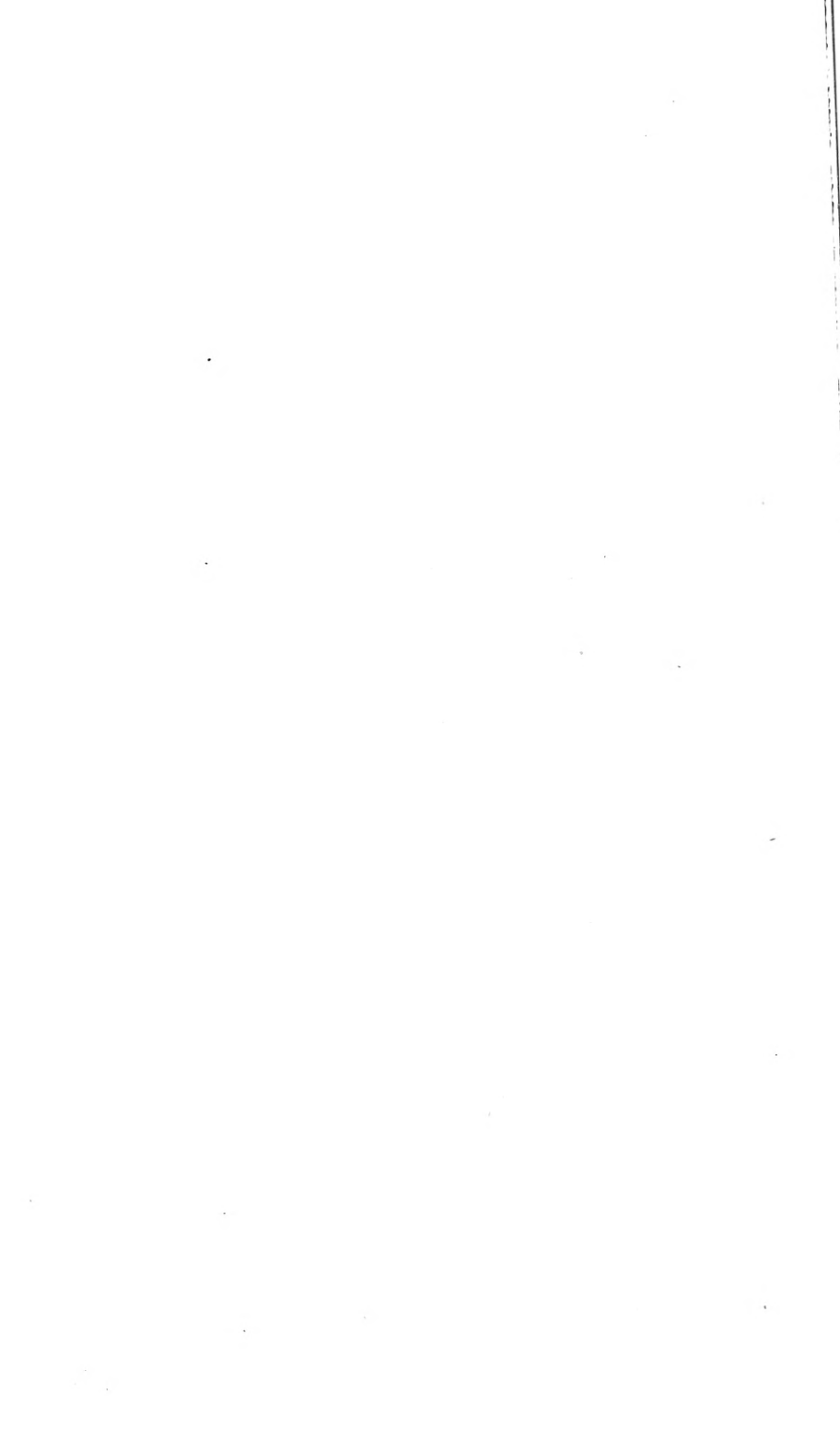
JOHN K. HALLOWELL.

DENVER, COLO., June 1, 1883.

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Gunnison, the Bonanza County.



CHAPTER I.

Former Ideas of Gunnison County—View from Marshall Pass—Gravels at Gunnison City—Crested Butte—Tertiary Fossils—Crested Butte Mt—A Dream.

Had anyone said to me in the year 1881 that in 1882 you will be in the Gunnison country, looking it over, the same as you have done other portions of Colorado, I would have laughed at them, and replied three to five years from now will be time enough for that. For the reason that heretofore it has taken five to ten years to prove practically the worth of a mining country, that capital might be induced to invest in means of transportation; have mines enough opened to prove to capitalists that there was sure returns for their investments, as well as possible large profits; and on that basis I have always maintained that the older counties of Colorado were much the best for the investment of large capital, as they had the following advantages, viz: mines opened, so that the country was proved to a point, that the investor could judge, relatively, what expenditure on an undeveloped property would result in; transportation by rail, making in most instances a cash market at the railroad shipping point; also a permanent mining population in numbers enough that labor could be depended upon at fair wages, and last, but not least, organized sources of supplies, which are brought to the mining camps and through competition vended at the lowest possible profits.

Such were my personal ideas and I was free to so express

them; but this spring I had to acknowledge, that what it used to take ten years to accomplish in the State of Colorado is now done in three. That the Gunnison country has railroad transportation and cash markets for ores produced; that already it has developed mines proving the different mining camps; that this year will see it teeming with a permanent resident mining population; that competition in the sale of supplies will naturally follow, and the probabilities are, that the next three years will see a greater proportionate demand for Gunnison County mines by capitalists than any other section of the State.

That at least seven years' time has been saved to the miners and prospectors of this county is almost wholly due to the energy, foresight, and business capacity of the managers of the Denver & Rio Grande Railroad Company. Their energy is shown in the fact that there is not a mountain canon that they needed to go up, but they said to their engineers, "find us a way through," and no matter what the difficulties, it was done. No mountain range has been too high for their workmen to find a way over. Their foresight is evidenced by the fact, that their surveying parties passed into each portion of the State along with, and sometimes ahead of the prospectors, so that when they built into a new country, it was with an almost absolute knowledge of its resources. Their business capacity is recorded in the fact, that they have organized and maintained a large and successful corporation, independent of any Eastern clique, but which belongs to the State of, and really represents Colorado as a railroad organization, and is not the tail of anything else. To these men much is due in honor and esteem, as well as profit, by the people of Colorado as a whole. This is no paid tribute to men who hold prominent positions in the State, for no man nor company pays me for this kind of work; and I claim the right to find fault where I think I can point out the better way, as well

as express my admiration and esteem of men whom I believe are worthy of it, and have, as I can see, done well.

I came to this part of the country partly on business for others, with a faint idea I could do a little for myself, and to get a personal knowledge, as I could work it up, of the geology of the mining districts on this side of the range. This part I desire to make public as fast as I can learn it myself, hoping it may be of benefit to others, of good to the State as a whole, and a portion of the results fall to me individually.

At Marshall Pass one gets the first view of the country west of the Continental Divide. On a fine, balmy morning, a few day since, I stood on the depot platform looking over miles upon miles of country; diversified by large valleys, smaller enclosed parks, beautiful winding streams, far-stretching woodlands, open grass-covered grazing sections, softly-rounded elevations among the foothills, all with snow-clad mountain peaks rising heavenward for a back-ground.

To stand on the edge of all this at an elevation of over 10,800 feet, in such a clear bracing atmosphere, with such sunlight and gentle breezes as only Colorado can have; to look outward and beyond with the feeling that here was a new country where much was to be learned and told; to feel what it possibly might be to the world at large, was to be overcome with an awe that was mingled with a reverence devoutly thanking God that one was alive, able and willing to do in this day and year of the Nineteenth Century.

The first thing observed in the descent into the valley below was its apparent abruptness; as instead of the long laborious ascent from the eastern foothills over miles of uptilted, hard metamorphic rocks, to get to the central axis, or primitive granite nucleus of the Continental Divide, here the more recent formations, such as post cretaceous

and tertiary, appear to abut directly against the primitive granite. These rocks being generally built up of strata of soft friable sandstone and shale, with intermingled strata of limestone, most of them not very compact. The rocks being of this character, the great erosion of these valleys is accounted for, as well as the low, rounded, heavily timbered hills making the dividing ridges of the numerous small valleys of this geologic section. The country along the railroad appeared to have much of a sameness, as to its geology, after descending the mountain slope through to Gunnison City. Nowhere could I be sure that I recognized the heavy bedded metamorphic rocks of the eastern slope, although studying geology on a railroad train at the rate of fifteen miles an hour is not a method that insures accuracy.

Having to wait at Gunnison nearly two hours, I took time to examine the open gravel bed near the depot, feeling sure that here I would find an accumulation of samples of the country rocks brought down from the heads of the streams centering here. What struck me first was the great variety of the boulders representing eruptive rocks, making fully nine-tenths of the whole, from the earliest granite porphyries, down through the rhyolites to the most recent lavas, represented by black vesicular boulders, with very large air cells, or blebs, in fact a very coarse pomice stone. Intermingled with these were some of the sandstones evidently only moved a short distance, and occasionally a black limestone pebble saying, "at my home we have layers of coal."

All of these samples to me meant business, and were the first alphabetical letters of my future knowledge, and gave me the idea of what I ought to find, which would be outlined in this manner. In places the granite porphyry outcropping through eroded sedimentary rocks, with possibly more recent volcanic rocks beyond and higher, caus-

ing by their eruption fissures through the earlier eruptive as well as the sedimentary rocks. The filling of these fissures would be like the ore bodies and mineral veins of those at present known in other sections, the granite-porphry being really the country rock, and only lightly overlaid with sedimentary material. I ought to find these veins large, continuous, with abundance of mineral, and the ore possibly of an average high-grade. That is what the pebbles of the gravel pit said to me ; it remains for future work to prove how near I read them aright.

Leaving Gunnison Junction, the railroad follows Slate river westward for about thirty miles, gradually climbing in that distance nearly 3,000 feet, and having for its terminus on this branch, the town of Crested Butte, the place taking its name from the most prominent landmark at the entrance to this geological basin. This town is located in one of the finest Colorado valleys that I have seen, with every evidence of natural wealth second to none, to be realized upon by the labor and capital of the future. Just back of the town are the coal beds, known to be three different stratas, not many feet apart, and ranging from four to eleven feet thick, of as fine fuel as is known anywhere. The strata apparently undisturbed by the gradual elevation of the whole country from at, or near sea level to its present height. I had asked many if they knew of any fossils connected with these sedimentary deposits at this place ; no one of many had seen them. The first thing I done was to look for them, as their presence or absence meant much, as well as the kind of fossils, in telling the story. I had no difficulty in getting the most beautiful impressions of the leaves of deciduous trees, and the one that had the most to say was a palm-leaf, for it said, "when I grew on lands near by, where you find me, there was a scorching sun, a moist climate, hot, murky vapors arising from rank decaying vegetation, a sea not far off with fresh

water streams running to it through lowlands, sluggish and tortuous in their course, great marshes bordering the coast, in fact, to be only compared with the rankest tropical climate of to-day."

The books said that here was the closing of the postcretaceous age, and the sandstones overlaying were possibly the commencement of the tertiary period.

A botanist would go into ecstasies over the Flora of these sedimentary hills, flowers in bloom without number, and some that I never had seen before.

Of fossils I could not find here any sea life, not a shell, fish-tooth, or cast of one. Now this to me means a great deal, as when the condition of an ocean or sea depositing sediments, afterward rock, is such that there can be nothing living that moves and has an individuality of its own, there must be peculiar causes. Those causes must come from the lands adjacent, and where there has been such an effect as here, I hope in time to be able to show the cause.

My next effort was to climb Crested Butte Mountain, to see what it was made of, as well as to get a view of the surrounding country. Striking straight across the valley from the Elk Mountain Hotel, and noting the immense amount of erosion done in past time by the Slate river, which here follows a winding, tortuous course through grassy meadows. I learned as I approached the other side that the strata was cut down below the known coal beds, and that if any more than the three known were in existence they would show outcrops or signs further down the Slate. The change in the Flora on this side of the valley is remarkable, the plants and flowers of the coal measure side outnumbering this side of the valley more than ten to one. I found Crested Butte Mountain to be a homogenous mass of eruptive rock, with feldspar and silica for a base, enclosing crystals of feldspar, crystals of hornblende, also of sanidine and some small scales of mica, evidently a black

amphibole; in fact, the whole mass was granite porphyry, the oldest rock I shall find in this country I expect, but not so old itself but that I found it enclosing small fragments of a still older rock. Could these fragments only talk what a history they could relate.

Leisurely picking my way up, up, and ever up, I finally arrived at the highest growth of trees of this mountain. Here was a patch of snow, from which a clear stream of water, such as you read about, ran, and here I rested and dined—a chew of horse-shoe plug, a drink of snow-water with a cigar for desert comprised the frugal meal. But when a grand glorious panorama was spread at my feet (now that is as near being aesthetic as I consider it necessary for a Coloradoan to get); back of and above me still towered some hundreds of feet of the bare rocky crags of Crested Butte; to the south and southeast were the heavily timbered sedimentary rocks, with their wealth of coals, backed by snow-clad mountains of apparently the same formation and age as the one I was on. While north, northwest, west and southwest, were huge snow-clad pinnacles, showing in some places the sedimentary rocks carried up and covering their tops, with horizontal strata appearing on their sides, diversified in the northwest by the strata being tilted on one mountain apparently dipping southeast, or another inclined to the northwest, showing thin-bedded strata over this locality and a fold over a possible granite porphyry axis below.

At my feet to the south was the town of Crested Butte, beautifully located; to the west Gothic, nestling in a green valley; wagon roads winding in various directions up the valleys; overhead the blue vault of heaven; at my side the breeze gently murmuring through the evergreens, giving the soothing gentle touch that only a mountain breeze through the pines knows how to give. It was a spot and scene for the poet and painter.

As I lay outstretched, filling myself with the miles of wonders before me and perhaps gradually dropping into unconsciousness, I seemed to hear a voice speaking in this wise: "Ah, me! my friend, you are only looking upon a wreck of what was. Could you only have seen me in my glory and pride, when I was an island in the midst of a glorious sea. At my feet were shorelands covered with tropical vegetation, up my sides grew such grand trees as you never saw. I stopped the passing clouds and down my sides ran the tumbling waters, while with my head above all, I laughed in the sunlight as I enjoyed my bath. How long this time went on I cannot tell as you count time, but it was ages. Then came a change. I do not know the cause, but the waters rose around my sides. I could not see the shore lines, the boundaries of this sea, and occasionally some massive head like mine, was struggling above the watery waste. I say waste, for no life appeared now in this sea, but a nasty, slimy mud alternating with sands was laid around the lower part of my body, shallowing the waters until what was once deep sea, became wet, boggy marshes, full of rank, rapid growing vegetation, vast beds of it, as far as the eye could reach. It was what makes your coal beds now. Again the waters rose, and with the clayey sediment washed from adjoining lands came floating patches of leaves to sink and be buried at my feet, grieving me as I recalled the life and light that once were mine. This was repeated many times. The waters kept rising—you would say I kept sinking. It matters not, the result was the same. The last glimpse I had of my comrades was to the southeast, where they still kept above the waters. Look at that mountain directly west, with the mining village at its feet. He is my brother and went down with me. To the northwest the water was still deeper, and vaster beds of these muds were laid down. I was near the sea border. Finally over my head the

waters passed, and I could only guess at what was being done. I was bound in the tightest of dungeon fetters, and felt the masses of mud still growing above me. From their oppressive weight, I knew I was carrying hundreds of feet, and all hope of ever seeing the blessed sunlight was gone from me, I felt forever. Ages upon ages passed, then came the rumbling of earthquakes, strange movements I felt, and stranger sounds I heard. Everything appeared to be breaking and smashing but a short distance off. I was sensible of a movement up, up, and still upwards, slowly but always moving; would I never stop? I was bound and blinded, yet, surrounded by the hardened mud-masses of the old sea, and at last I seemed to rest. Gradually I heard noises of rushing, roaring waters; these mud-masses appeared to be torn from my head and sides by an irresistible force; gradually I saw the light, then the sun again. By my sides were swift running waters, of a kind new to me, for they were cold, and chilled me through and through. I noticed the rains of former times were now white fleecy masses. Surrounding me were new acquaintances, great towering fellows, covered with congealed waters that came rushing down, as melted in the summer's sun, tearing and grinding about me, laying my sides and ribs bare to the snows and wintry blasts. These new friends are unlike anything I knew before; reaching high above me, I can see they are different from myself, evidently built of the muds of the deepest part of the old sea, and their height above me showed how deep was my burial place. My brother there to the west shook off his grave clothes as I did, and together we have been through all these ages of change I tell you of. But I do not like it now. Your snows, frosts and falling waters are slowly but surely working my ruin; gradually I am wearing away, and can only look forward in the future realms of time, to become as naught, or existing only in fragments along

miles upon miles of running waters, who still break me up to smaller fragments and particles, atoms of which go down to the great sea, there to make parts of a new rock and perhaps in time a new world. It is this looking forward to the unknowable I dread, and cannot help myself; these rude elements are stronger than I am."

"But, hark ye, my friend; could you see the marvelous changes that I have witnessed, in all of its minutiae, you might then talk of your knowledge as a science. But keep on working, for those who come after you, will profit by what you learn, and many shall come after you and I are gone, gone."

I awoke with a start to find that old Crested Butte had set me to dreaming, and that I had only two hours to get back over ground that had taken six to come. I made it though in time for supper, as a second aesthetical meal I had no ambition for.

Of this town of Crested Butte, its present and possible future, I will have something to say in another letter, as well as sundry future letters, regarding the surrounding mining camps, as I have opportunity to see them. As I fear that I have made this letter unreasonably long, I will merely add that the Elk Mountain House is managed by the town company, and if they will always keep as good a hotel in the future as now, may it be my lot to spend a portion of each summer with them.

CHAPTER II.

**Evans' Basin—Ideas on Prospecting—Sulphur Spring
—Hayden Lake—Pittsburg—Colorado
Anthracite Company's Lands—
Tertiary Coal Measures.**

Since writing you before, the weather has been quite showery, and somewhat interfered with my getting around as much as I wished to. However, I have done some work and herewith is a synopsis of what I have seen, and as I understand it.

My next climb was up to Evans' Basin, from a place on the Irwin road, about three miles from Crested Butte; what the elevation was I do not exactly know, but after a laborous climb through swarms of mosquitos, over fallen timber, through brush and other obstacles, I found myself past where timber grew and patches of snow lying around, (I see the thermometer is over 90° in Denver) here I found an immense outcrop of porphyry, well stained with iron oxide, and a great deal of good looking quartz float lying around, some in large masses, all indicating the presence of an ore body in connection with this porphyry. This mountain is composed of sedimentary rocks from bottom to summit which belong to the Crested Butte coal basin. Provisionally I must keep these coal measures by themselves, until I can find something I can compare them to, as I know nothing recorded that agrees with the formations here, in their details; consequently I have to be very careful in generalizing at all, and wish to be very sure of my facts here before I draw deductions, that might turn out to be erroneous in the future; but I have seen some strange things.

Evans' Basin illustrates very well a portion of the mineral bearing districts of this section, and the difficulties a prospector labors under. There is on the mountain side, two to three thousand feet of wash and slide, before I came to this porphyry outcrop, which breaks up through the coal measures, and comes through so nicely that the horizontal strata of the coal measures are merely fissured, no other disturbance apparent, and there is no change in the country rock. It is just possible that the porphyry was there before the coal measures, I am not certain yet.

It is at such exposed places as these, high up near the mountain summit, that the mineral bearing rocks are exposed by erosion; up here is where the prospector finds his surface float nearest in place, finds his vein, makes his location and does his work.

There were two gangs of prospectors at work on each side of the basin the day I was up, and working in most inaccessible places. If the ore was worth \$1,000 per ton it would take large capital to make it practically available. They were up over 200 feet above me, and from the stuff rolled down, they had not got as good material as lay at my feet, and which evidently came from nearer by. The average prospector is a marvel of a biped, but I do not know that the average mine purchaser is any less of an anomaly.

From what I have seen here I am inclined to the belief, that there are larger and better veins lower down the slopes of these mountains, but so covered by the detritus that no ordinary surface indications are visible. I say larger and better because if they do exist at all, the top of the original vein has been loaded down with the rest of the country rock, cutting it down many hundreds of feet, and bringing the present vein top nearer the source of supply for the fissure filling, resulting in a larger crevice at such places, and larger bodies of mineral. The gangue or crevice

matter of this country is generally with the best ores and largest bodies of mineral, a much softer material than quartz, a composition that would disintegrate more readily in winters' frosts, and wash out by melting snows and rains, than the surrounding layers of sandstones. This action would leave a sag in the ground surface, which the disintegrating country rock would wash into and finally fill; the result being that the whole mountain slope for a couple of thousand feet, appears to be a mass of broken sandstones, fine soil and rank growing vegetation, and the best veins are thus buried, making the prospector climb 3,000 feet higher and get less.

Right here I feel that the worthy prospector has the right to remark, "what is the good of all this palaver if we cannot find the veins?" Have patience my friend, knowing the causes that have produced obstacles, rather than anything else, there certainly may be found a way to overcome them, and knowing these causes, we can work more intelligently, especially if satisfied that the result will be pay ore.

My next trip was seven miles up the Slate river to the town of Pittsburg, I went in company with Mr. Geo. W. Cole, manager of the Colorado Anthracite Coal Co. On the road about three miles from Crested Butte we stopped at a large spring of sulphur water, and filled up with the only mineral water I ever tasted fit to drink; clear, cold, pure and soft; just sulphur enough to give it a fair taste, it really was delicious. There must be considerable sulphur in the water too, as the grass through which the water ran from the spring was heavily coated with a white sulphur deposit. Within half a mile of the spring is Hayden lake, which has some peculiarities that I have been told of, and which I hope to be able to investigate during the season.

We only stopped long enough in Pittsburg to see that here is an opportunity in time to make a mining town; but it would seem to an outsider that if the men most inter-

ested in making a town and selling lots, had much confidence in it themselves, that they would make a good road to it. The drive from Crested Butte is execrable, while a little money expended would make a good road, as the grade is not difficult, while of the material to be moved plows, and a road scraper will do it all.

On the way back we stopped to visit the above mentioned Company's coal lands, 2,500 acres, and located on each side of Slate river. The taking up of the land on each side of the river, certainly evidences commendable foresight, as it practically makes all of their land available for development. On the portion located, on the dividing ridge between Washington gulch and Slate river, we climbed up the trail nearly 1,000 feet to the first opening, and then did not appear to be more than half way up the slope, which is quite steep. We found the men were drifting in through the slide, near by which there was the appearance of coal float, showing well. As they had not got through the slide to solid formation yet, it was impossible to tell how near they were going to strike the vein they were after; but from appearances, a few feet further would bring them to solid formation of some kind. Mr. Cole, the gentleman in charge, having had large experience in Pennsylvania coal fields, is just the man to open up a territory like this, as past experience enables him to make the work done show, at the last expense, whether there is coal in this territory in paying quantities or not. From what he does, others owning coal lands in this section, but not having the experience in opening up of such mines, will be able to learn much.

I went without a drink all day, to be able to fill up of that sulphur water on our way back to town. I cannot say more in favor of any *water* than that.

There are some things in connection with these coal measures, that I am not fully satisfied of, and will have a

full description of them, as I can learn them, for a future letter.

This much I can say, however, they are of immense commercial value. While only three seams have been opened and really tested, I am satisfied from what I know already, that there are five if not six veins all told, in these coal measure formations.

CHAPTER III.

Fourth of July, 1882—Washington Gulch and Placer
Mines of 1859—Elktown—Painter Boy and
Silver Jewell Claims—Character
of Veins—Elk Moun-
tain House.

CRESTED BUTTE, Gunnison County, Colorado, July 4.—
This is the day we celebrate, and this is how I celebrate, as
I saw enough powder and smoke years ago to last the bal-
ance of my life. On being told that there was gold placer
mining between six and eight miles from this town, near
the head of Washington gulch, I thought it might be of
interest to myself and your readers if I looked it over; es-
pecially as report said the placer was worked as early as
1859-'60, and more or less continuously since. Passing
along the Gothic road nearly two miles from town, and
through the first toll-gate, then taking the first road north,
you enter Washington gulch. It is one of the mountain
valleys with the characteristics peculiar to this section, and
which are such a constant surprise to one only accustomed
to the eastern slope of the Rocky mountain system.
Imagine yourself driving along a fertile valley for six or
seven miles, over and around large mounds of detritus
from the coal measures, covered with luxuriant mountain
grass, over a foot high, at an elevation of about 9,000 feet
above sea level. To the west is the dividing ridge between
Slate river and Washington gulch, covered with a heavy
growth of timber on this side, suitable for mining purposes
from bottom to summit, and covering the seams of coal,
beds of sandstone and slate, of which this ridge is com-
posed. To the east is the connecting link between Gothic

and Crested Butte mountains, an outcropping ridge of granite porphyry, which is broken through in two places into the next valley east, and which breaks are filled with low wet ground, making a rich grassy swale. In places, one could see the uneroded shales lying against the eruptive rock, their soft bluish tinge making a pleasing contrast to the cold, grayish-looking, hard rock outcropping above them.

Driving along an excellent road, as one approaches the head of the gulch, one sees buildings, saw-mills and other improvements. Amongst these I shortly arrived, to learn that I had driven to Elktown, the headquarters of the Elk Mountain Consolidated Mining Company, and to find out, to my disgust, that I had paid toll to travel over a road on which the toll-road company had not expended one dollar, but the excellence and entire making of the road was due to this mining company. I consoled myself with the fact that the toll-road is owned by down-East parties. I hope no Colorado man would do such a thing as this, but for sweet charity's sake let us think that the toll-gate keeper has misunderstood his instructions, that the matter will be corrected, and that this kind of road-agent's work will be stopped. They certainly had no right to charge for more than the distance between Crested Butte and the toll-gate, a short two miles.

Having run on to something I did not expect and in my line, I speedily introduced myself to Mr. M. J. Gray, manager, finding a pleasant, genial gentleman indeed, and one who took every pains to give me all the information I desired.

I learned that the town, saw-mills, and the mines, seventeen mines in number, with about \$200,000 expended in development and surface improvements, belongs to the mining company. Their property is now brought up to a condition, when another years' careful work and economical

management ought to place the property on a dividend-paying basis, with two to three years' working expenses and dividends ahead in sight, as stoping ground opened. The elevation being only 10,000 feet, there should be no difficulty in arranging to work the whole year through.

The Painter Boy and Silver Jewell claims, both on the one vein, show the most ore for the development. They have good mine buildings, in which is placed the hoisting power, furnished by Hendrie & Bolthoff, of Denver.

Developments consist of a main hoisting shaft 100 feet deep, with a level in one direction of 100 feet, and in the other 300 feet, connecting with an air shaft 130 feet to the surface on the next claim. Considerable ore has been taken from this development, as the vein is fifteen to twenty feet wide, with well defined walls, porphyry on one side, a feldsite with some silica showing, and containing considerable fine iron sulphides, a rock I like to see, as I know what it means. The pay streak is twenty-two to twenty-four inches in width, and I was informed that this width would average \$200 per ton as it was mined; that they are selecting and shipping now from this a grade that will average \$500 per ton in milling. I should think it might, as I found plenty of native and ruby silver, with silver-glance, and high grade galena in what had been thrown out as third-class ore. I should estimate there is at least 100 tons of this on hand.

The gangue of this vein is something that would make the heart of the average Cornish miner leap for joy on contract work, being calc-spar—the easiest, nicest rock to work that ever a drill was pounded into.

The difference of hardness between calc-spar and quartz gangue being as three is to seven in the mineralogical scale.

From what I saw of the undeveloped claims, surface

indications mark as good properties yet to be opened as the ones I have described.

There has been some 1,900 feet of tunnel work done, but if with any practical results, I think, it is yet to be learned. However, this little spot controlled by capitalists of Topeka, Kansas, shows a geological structure that is right, and appears to have such a promising future that I most heartily congratulate the owners. I drove away with the feeling that I had seen and learned something, that it was a real pleasure to come across.

I learned that I had passed the placer ground, and that work had not been commenced yet this season. Was informed that the gold was quite coarse, easily saved, and that a great deal of value had been obtained in past years, without the ground being yet exhausted.

I could not learn that any gold bearing veins had yet been discovered in the locality, the fissures yielding only silver so far as opened, and not to exceed a half ounce of gold to the ton. I cannot conceive that the wearing away of such veins could give the quantity of placer gold reported.

Since the foregoing trip, I made a flying visit to the town of Irwin, and the Forest Queen mine; but found this vicinity so much more developed, so much more to see and know than I anticipated, that I concluded it best to leave it for a few days, until I could give it the time and care that I ought to, and which the locality deserves.

Really this Elk Mountain House surpasses all of the mountain hotels that I have ever stopped at. I have just got up from as good a Fourth of July dinner as I ever ate anywhere, and although a day on which more license is generally used and not noticed, than on most other days, here every thing, with a crowded house is so orderly, running so smoothly, and withal, such care and attention given to each guest, that it is a real pleasure to speak of it.

CHAPTER IV.

Poverty Gulch—Crest of Elk Mountain Range—Little
Nell Mining Claim—Nearly an Accident—
Lunch—Rainy Weather.

CRESTED BUTTE, Gunnison County, Colorado, July 7, 1882.—Since my last letter, I have had an opportunity to visit another mining section, tributary to Crested Butte as a shipping point.

On July 5, on the invitation of Mr. J. J. Ellingham, formerly sheriff of Boulder County, Colorado, and in company with Mr. F. Dillingham, of the Denver Sampling Works, we started from this town on horseback to see the wealth, present and prospective, of Poverty gulch and basin. The names of localities in this section, like all other new places in Colorado, are quite euphonious.

We rode up the Slate river valley to Pittsburg—this part of the country I have already described—but from Pittsburg on up the gulch the territory was new to me. A good wagon road winds up the rising ground of the gulch, as far as it is practical to make a road at present. Then after crossing the stream in Poverty gulch the trail ascends quite rapidly, until we had climbed up amongst patches of snow. Selecting a spot where the grass had got nicely started, we picketed our horses, concluding that here navigation ended, and that the rest of the way must be made on foot.

A ten minutes' further climb to an elevation of 11,500 feet brought us to the tent occupied by Mr. John T. Williams, prospector and claim owner, who was formerly in charge of the Bull Domingo mine, of Custer County, Colorado, a man well and favorably known in several sec-

tions of Colorado. He, with his men, occupied this tent, and not far from this elevation he had put in the winter.

Taking a hearty lunch, for we had 500 feet higher yet to climb, and a snow field of at least a third of a mile to cross, four of us set out, and after one got at it and used to digging the toes and heels into the soft snow, it was not so bad, as we angled along a slope of at least 45° , where if one slipped, the descent would be more rapid than pleasant and the stopping point—I cannot tell whether one would halt in this world or keep right on to the next. They told of a burro making the trip with a load on him, and halting all right this side of glory. That may do for a burro, especially if he enjoys it, but as for me, I prefer to keep the trail.

Over the snow and a few feet up, what a sight and what a place. I stood upon a crest of the Elk Mountain range, not over twelve feet wide and, perhaps, three-fourths of a mile long. Under my feet was the beginning of the world; that is archæan granite; within a stones throw was the most recent formation known; what an eventful history between the two. I stood at an elevation of certainly 12,000 feet above sea level, down from me, on each side, were sheer precipices of 300 feet on the east and 700 feet to the west.

Raising my eyes and looking westward, I viewed a vast reach of country, of valleys, of hills, of mountains; grass-clothed, forest-covered and snow-capped, bounded in the distance by the grand-looking Wahsatch range of Utah, and all of the unknown wealth of a new country between us. Turning to the east, Crested Butte town, nine miles distant, seemed at my feet; on down the Slate river, with its tributaries, to its junction with the East river, up the valley of the Tomichi, and my eyes rested upon that monument of the world, the Colorado Continental Divide.

We did not come entirely to look at scenery, or for

the benefit of our health; so at the word from Williams, who took the lead, we went over the west side, and along the edge, on what was meant for a trail, and which can be made into one. Sometimes down, then scrambling up, finally arriving at a dump of vein or crevice material, over which we climbed, stirring up the loose, friable stuff, which as we tramped upon it gave out a strong smell of sulphur, and no bad sign either was this dump, for it showed from quantity evidence of a large vein, and in composition an easy material to work.

At last we stood at the entrance to the Little Nell mining claim, a property that is attracting considerable attention in this locality just now.

This claim was located in 1881 and has several openings on it, all showing ore in place, principally galena, running well in silver, and some of what I should judge was magnetic iron pyrites, but cannot be positive without a test. We visited all of the openings, and at each place found a large showing of solid ore piled out. I mean a large amount of ore compared to the amount of development, and of a quality on which I was assured there was a round profit over and above cost of mining, shipping and reducing, which, I confess, is remarkable, as it is very seldom that such a grade is obtained in the quantity showing here with so little development.

As it was thought necessary for me to go over the vein surface showing, that I might give a competent opinion as to the permanency of it and its prospective possibilities, we prepared to start. I looked up an angle of 70° for 250 feet to the mountain crest, along a sag in the mountain side marking the course of the vein, with its granite walls standing up on each side; then turned and looked down the continuation of the vein, gradually widening between walls as shown on the surface, for over 400 feet, until the vein course, and walls were covered in the detritus below.

I had selected about twenty-five pounds of the representative material of this vein ; the sack containing it I slung on my back and up we started, Ellingham ahead, myself next, with Mr. Dillingham and Williams following. We could only scramble a few feet when our wind would give out, and we had to stop and breathe ; somehow or other, the capacity of one's lungs in such places seems to be too limited. As we stopped we could examine the crevice matter, seeing solid galena out-cropping, accompanied by the decomposed ores, such as carbonates, and a showing of chloride.

About half way up, I was nearly the cause of an accident that at the time made my heart leap into my throat. I was quite heavily loaded, and using the projecting rocks to assist me all that I could, I reached up and put my hand on one apparently firm, of many pounds weight, when it started. I had just time to brace myself, try to hold it, and call out to those below, who succeeded in getting to one side, as I had to let it go, crashing many hundred feet down the mountain. I tremble now to think what might have happened had I not had the presence of mind and strength to do as I did at the moment.

At last we stood upon the crest again, and quite thankful all of us to get there once more, except Williams, who appeared to take everything as a matter of course.

I can assure the owners of this mining claim that they have a crevice which is a true fissure, cutting the granite crest through and through ; that its possibilities are not shown yet, as I could not see that either wall had been reached in the work done, but an out-cropping ore streak had been followed in the development.

When a vein of this strength shows a pay-streak, with crevice material on each side, my experience says that with development other and additional pay-streaks will also be found. They assure me that the grade now is profitable

pay. I know from what I saw, quantity enough could be procured. While this is not a developed country, so that there is anything in the neighborhood to compare possibilities of development with, I can, in this country rock, feel safe in saying that from what I know of similar veins in other parts of Colorado; the owners need not be afraid of pushing development, as I do not think, from what I saw, that they will be troubled with pinches that will be any detriment, or with, what is known in miners' phraseology, a "horse," that will cut off the pay-streak entirely, as occurs in some formations. This property has every evidence, as far as surface showing and development goes at present, of being made in the future a valuable producing mine.

Having a little time left in which to gratify my natural curiosity, I espied some rocks which I wanted to examine, Williams saying they were only about 300 feet off, and, offering to go with me, we started. I will bet—not money—that it was a fourth of a mile, and as we went below the crest, we had afterwards to climb 200 feet to get to what I wanted.

I found it was contact between the granite and another rock, so weathered and stained that I am not sure yet of its name in geology; also a large dike of feldspathic porphyry filling the place of contact. It really did me good to see here the porphyry the same as I find it in Clear Creek County, and the granite the same as Boulder County. These rocks seemed to me to be a connecting link between what I already knew and that which I am striving to learn.

We went back along the crest, and in a nook sheltered by angular masses of granite, were two men with bellows and the requirements of an out-door blacksmith shop, sharpening tools. I am not surprised at anything any more. Of course, they were the kind of men that have done most to make Colorado what she is, worthy member,

of the great fraternity of prospectors. May success attend their efforts.

We found that the rest of our party, tired of waiting, had started for the tent. That meant "grub." We were hungry, too, and hurried along the crest rapidly, stepping on angular fragments of granite, of all shapes and average sizes of cooking-stoves, where a mis-step or slip would—well, it made no difference which way you fell, you was sure to go down many feet.

About half-way across the snow field one of our comrades who had preceded us, evidently, had suddenly conceived the idea that he was a boy again, and had went down the snow-slope the same as he had used the cellar-door in boyhood days; there was his mark in the snow. He said afterward he did it for fun. He has been in Colorado over twenty years, and those of my readers who personally know him, will know how much reliance can be placed in his statement.

At the tent we found hot coffee, hot bread and ham, and a dish of—I am not up in cookery and cannot name it, but it was mighty good anyhow, and to it all we did ample justice. Williams' cellar is in the snow-bank, just across from the tent. As the snow melts he keeps moving the door of the cellar across the gulch after the snow-bank.

I must go up to this locality again, as, in a space of less than a mile square, I saw more varieties of rock than I ever before saw crowded into the same space; and when Nature starts in to make a geological museum, I want to paw over the rocks.

As we saddled and started homewards, it began to rain heavily. (They say this is the dry season here). It has rained hard some part of each twenty-four hours that I have been here, and we did get soaking wet. Arriving at the hotel at 8:30 P. M., as I tumbled off my horse, cold, wet through, sore and stiff, I was conscious that I had seen and learned something new, and in my way had enjoyed a good time.

CHAPTER V.

Iron Swamp—Irwin—Pioneer Mill—Forest Queen Mine.

IRWIN, Gunnison County, July 14.—Since writing my last letter, I have been under the weather a couple of days, probably the result of over-exertion, and was compelled to keep quiet. However, on the afternoon of the 11th instant, I felt like trying myself, and struck out for a three-mile walk on the Irwin road, to what is locally known as the "Iron Swamp." Across this swamp the road has been made, by laying down heavy sticks, and corduroy wagon way on top of them. The geological formation shows contact between the sedimentary rocks, or coal measures, and the granite porphyry. Possibly an eroded basin, with an ore body filling the place of contact, showing near the upper part of the basin, while the lower part, toward Coal creek, the line of drainage is filled with gravel. In most recent times waters flowing from the upper part of the swamp have been very heavily charged with iron, which is deposited over the gravel three to four feet thick. Some of this is claimed to give, in laboratory tests, 60 per cent. of iron. I could not learn if it carried other value or not. The running water draining from this swamp, now stains the logs and stones of the dull red color of some mineral paints. If this property is ever worked and properly developed, I rather imagine a different ore body, of very different material and value, will be found in place than what the surface shows at present.

I had collected about forty pounds of specimens, and felt rather played out, when a wagon came along that gave me the chance of a ride to Irwin. As it was a question of

walking back to Crested Butte, tired out as I was, or riding to where there was something I wanted to see, and where I could spend four or five days to advantage, it did not take me long to decide, and, of course, in favor of the ride.

Arriving here about supper time, I found several acquaintances, whom I have known more or less of since I have been in the State, and especially the gentlemen connected with the Forest Queen mine, the bonanza of the Ruby Mining District.

Irwin is a mining town, pleasantly situated at an elevation of 9,750 feet above sea level, a place which, if there was a little more attention paid to the streets and their condition, could be made a handsome mountain town. Comparatively speaking, it is young yet, being wholly the out-growth of the discovery and out-put of the Forest Queen in 1879, with many subsequent rich discoveries in a radius of five miles, helping to make up the whole. It is the supply point of as rich a mining district as is known anywhere over the range, with a population at present of over 2,000, and which, in the next thirty days, I am assured will be doubled. Owing to the lateness of the season this year, very many who put in the season here actively working, have not returned yet, but will put in an appearance soon, besides bringing many new men with them, so that a few weeks' time will make every difference in work done, and in that time the surrounding mountain basins will be resounding with the explosions of powder and rending rocks, while Irwin, as a supply point for a rich mining district, will show the bustle and activity of business that it deserves.

There are two or three good hotels here, chief among them being the Windsor.

There are school houses, a neat little church, and more business houses by far than Crested Butte, although that

is the shipping point that Irwin is tributary to. My first visit was to the mill built by the Goodenough Mining Company, under the supervision of Professor (?) Jacobs, and like many of the Professors's (?) experiments, turned out to be an expensive one for the men who furnished the money. It does seem too bad that such men do (and always will) find men with means who will advance money for the most impracticable operations in connection with mining, the result of which is failure and loss. If the whole loss fell upon the men conducting such enterprises, it would not be so bad; but, the worst part lies in the fact that the failure acts disastrously on the surrounding camp and other investments. It is also used as a means of ill to the locality by the very men who have caused the failure, and whose only claim to public notice is their burden of conceit, ignorance and stupidity. Graduating with these talents, they may rightly be styled "Professors."

This mill is now represented in ownership by Mr. Marshall Webb, of New York City; and one must really admire this gentleman's pluck in trying to make the best of what has been done. The mill is now being remodeled so that sampling can be done and ores purchased, making a cash market at home for ores produced in this neighborhood. This is what all mining camps need first, a cash market at home, so that a prospector with only his labor and locations for capital, can turn the results produced into cash, be it 500 or 5,000 pounds of ore, and with that money can hire labor and so produce the larger amounts afterwards, thus making a steady, direct and beneficial result to a mining section. The very money that is often tied up in impracticable reduction works, in partially developed districts, will more than furnish the capital for the business, and the chances of profit to the capitalist, with only a sampling mill, are very great, as the

business is cash throughout. His margins of profit are three to five dollars per ton for crushing and sampling, and an inside rate of freight that the single shipper of small amounts cannot get. Also, he can, on large contracts with the heavier plants for reduction, get a fair reduction in cost of treating the ores he purchases. It does make me sore as I visit different parts of the State and see capital tied up, that, in other channels, might be used profitably for the capitalist and for the benefit of the district as a whole.

Mr. Webb is to be congratulated that he has taken a step in the right direction, and deserves the thanks of this district in showing that he is trying to meet the real needs of the locality.

The mill is a fine large one, well arranged in some particulars, and furnished with far better machinery than I expected to find. Under the guidance of Mr. Charles Butters, who is in charge, I went through the building. To his kindness I am indebted for the following particulars: The mill is furnished with a stationary engine, double cylinder, capacity of 100 horse power, manufactured by the Buckeye Engine Company, of Salem, Ohio. It is a model of workmanship. The boiler, with more than the power of the engine, is one of Babcock & Wilcox's best make, one of Blake's largest size ore breakers, capacity of five tons per hour, a ten-stamp battery for dry stamping, a revolving cylinder for drying ore, furnished by the Frazer & Chalmers, of Chicago, two revolving chloridizing furnaces, capacity four tons each per twenty-four hours built by Morey & Sperry, improved Union Amalgamating Pans, capacity twenty-five tons per twenty-four hours, make up the bulk of the plant.

The *modus operandi*, as I understand it, is briefly this: From the ore-bins to the crusher, then to the rolls where the ore is sampled and paid for. After that to the revolv-

ing drying kiln, thence to the stamps automatically fed, where it is reduced to a grade of forty mesh or finer, from there along an ore channel to an elevator. The powdered material is carried up and dumped into ore-bins over the chloridizing furnaces, into which the material passes with a sufficient amount of salt to make the silver contained in the ore, free milling. These furnaces revolve and a strong draft passes through them (I do not like that; there is too much chance for loss); being sufficiently roasted here, the charge is dumped upon an open hearth, there to remain several hours, then shoveled into ore cars furnished with a track across the mill floor, out of them to the amalgamating pans. From these the amalgam will be collected and reduced in a furnace recently constructed under the direction of Mr. Butters. It is capable of receiving a charge of over 1,500 pounds of amalgam. Attached is a model furnace with muffles for assay purposes.

We visited the weighing room, which is a type of neatness, well lighted and furnished with a number of improved scales and balances of various sizes.

Mr. Butters tells me that he takes the mill as he finds it, and will do the best he can with what is at hand, adding as little expense as possible. One can see the difficulties he labors under in getting started, as owing to the incapacity of former men, the foundations of parts of the mill were not made substantial enough, so that some of the machinery has to be re-set, shafting relined and adjusted, to say nothing of the vexatious delay of receiving parts of machinery ordered, which are to be used in the sampling of the ores, and which machinery is now being put to place and adjusted, with a prospect of starting in a few days.

Mr. Butters is confident that he can treat the ores produced here successfully in the above described method. I sincerely hope he will, as it will solve one of the knotty questions of ore reduction, and his success will reflect much

honor and credit upon him. The sampling and purchase of the ores, I know, can be made a profitable success.

The ore bins of this mill are now full of ore, principally from the Forest Queen, which is making a large output; ore is being produced in quantities from five different places in the mine.

From the mill to the Forest Queen is not much of a walk, and being the best developed as well as the oldest mine of the camp, it, of course, merited attention first. I learn its history to be briefly this: The property was discovered in 1879, purchased by the brothers, Harold and L. R. Thompson, for \$40,000, who organized a private company, associating with themselves such men as D. C. Dodge, R. W. Woodbury, Mr. Woodward, of Denver; William T. Holt and other gentlemen of like reputation and means. The first year's product of the Forest Queen was over \$40,000, the shipping ores netting \$350 to \$1,080 per ton in Denver and Pueblo, over and above the very expensive cost of transportation and treating of those days. This gave the mine a reputation the country over, aside from the remarkable specimens of ruby and native silver that were distributed all through the East in various ways.

The winter of '79 and '80 found the country new and still unprepared for active prosecution of work during the winter season. What work could be done, however, was vigorously pushed, drifts run from the bottom of a sixty-foot surface shaft each way, some of the pay stoped out; while at the same time a tunnel was started on the ore face, at the end and lowest part of the claim. Here they had excellent pay for a time, but passed it. In the sixty-foot shaft it was apparently gone, cut off; at the end of one drift it was pinched, at the other the ore had apparently disappeared, and from this the story went abroad for a time that the Forest Queen had lost her vein, and gave the Ruby Mining District a temporary "black eye." It cer-

tainly has been temporary, for the mine now is taking out an average of ten tons per day, which amount in the next sixty days can be trebled if it is desirable, proving that the vein and ore is there all right, and in larger quantities, as well as of more value per ton than the owners allowed themselves to hope for.

As I was allowed free run of everything, I prefer to state what I have seen myself, draw my own deductions of the future, and try to plainly place before my readers things as they are now, rather than to take up and point out the errors that have occurred, and which all realize and can understand now. For it must be remembered that here was a formation of country rock that was entirely new to all miners, a rock, the formation and characteristics of which are peculiar to itself.

The mine is now working something over forty men, under the direction of the lessees of the surface ores, under contracts for driving levels in connection with the tunnel, and others in the direct employ of the company at so much per day.

The surface of the claim measures 1,000 feet along the course of the vein, by 265 feet in width, and whenever I could get on to a part of the walls in place, I found it carried a regular dip approximating 45° to the southeast, the course of the vein being about northeast and southwest.

At the time of my visit I found Mr. L. R. Thompson, part owner and lessee from the company of the surface ores, seated alongside of a ten-foot hole, out of which a couple of men were handing out large chunks of ore, on which Thompson was exercising himself with a hammer, breaking the ore in sizes suitable for sacking. I saw him break lumps of 150 pounds and over full of ruby silver, that would go anywhere from \$500 to \$5,000 per ton, and as he rammed the pieces into a sack, he appeared to be full of remarks suitable to the occasion. To a "specimen fiend"

like myself, it was awful to see such beautiful specimens about to go through a mill; but what does the average mine-owner know about the æsthetical part of the business? The stuff that he threw to one side, as of not high enough grade to have treated at present, would make the average mine-owner green with envy.

Just above this spot is an old opening of 1879 from which surface pay ore was taken. I looked at it. The ore was east of the porphyry, and the other opening I speak of, had the same formation. I went down the sixty-foot shaft, along the south drift seventy-five feet, over piles of ore waiting to be hoisted up, to the end where the pinch occurred, and found the ore streak about four inches wide, the ore west of the porphyry. Within fifteen feet of this, understopping was being done on the face of over three feet of ore. I looked at the eighty-five foot drift west from this level into the barren sandstone or country rock; right opposite is the thirty-eight foot cross-cut, which was finally started in the right direction, east, going through crevice matter more or less mineralized, until the mineral became strong enough to be a regular pay streak. This has been drifted upon 130 feet north, and the ore is west of the porphyry. I went into the old north drift from this shaft eighty feet, and saw where the pay still stood along the east line of the drift. This shaft was sunk down 120 feet further, and not sufficient allowance being made for the dip of the vein, every foot of depth carried it that much further from the pay. After the re-discovery in the east cross-cut above mentioned, another cross-cut was run from the shaft at a depth of 120 feet from the surface, a distance of sixty-five feet, and nearly twenty feet of pay ore was cut. The ore is west of the porphyry. At the bottom of the shaft, 180 feet from the surface, it took seventy-two feet to cross-cut to the ore, and the ore is still west of the porphyry.

In company with Mr. Frank Winters, whom I have known for some time, and who now has charge of the contract work, etc., in the lower or tunnel workings, I visited this part of the ground.

Frank is a practical miner and a hard worker, one who sees much that escapes the notice of others, evidently the right man in the right place, and also has the honor of firing the first shots in the right direction, viz: in the upper east cross-cut.

When this tunnel was started much and good pay was taken out, and it is now being done from the surface over the tunnel entrance, where over four feet of ore is being stripped, and showing a large percentage of ruby silver. The tunnel, when necessary, is well timbered, a nice grade and track makes the complement for working. It is in a distance of 535 feet; a cross-cut from here reaches the ore body, which has been drifted south on for a distance of 130 feet, and the work still going; also drifted north on for fifty feet, a cross-cut here west in crevice material of twenty feet brought them to the real sandstone footwall, showing regular and in place, with its dip of 45° . Following a large pay streak north along this wall for 135 feet, regular almost the whole of the way as a line, it gives the impression that here everything is in place. From the workings here the whole vein formation can in time be proved. The last few feet in this drift shows a sandstone "horse," which has caused the ore body to leave the footwall and deflect into the crevice material eastward. At this point a cross-cut has been started east through the porphyry, now in twenty feet, and which, if carried right on through the porphyry, I consider the most valuable piece of development in the whole mine, as it will prove everything, and show that the only fault in working was occasioned by those in charge not realizing, until very recently, the enormous size of this fissure, and its possible showing in value.

To the kindness of Mr. Ira Brown, superintendent and in charge for some time past of the active working of the mine for the company, I am indebted for the permission to sketch the workings, and who kindly corrected the measurements that I might construct the geology of this vein, and which I find to be as follows:

The country rock is granite-porphyry, overlaid with sedimentary rocks, or recent coal-measures, many hundreds of feet in thickness. Following this were recent volcanic eruptions (I am informed of lava outcrops a few miles southwest showing in place), which fissured this country rock, the fissures breaking through the over-lying sedimentary rocks. Their composition being alternating layers of shales, coals and sandstones, all soft and friable, they fissured without any resistance that would displace them. Some of these fissures were of large size, allowing the passage to the surface of the eruptive paste, which makes a portion now of the true-fissure vein filling, is recognized as feldspathic porphyry, and which is always more or less mineralized. So much for generalities; now we come to the Forest Queen surface. Where large bodies of mineral occur, a trough along the vein will show, or if large enough over the largest bodies of ore in the vein, a basin will be formed. This occurs from the oxidization of the sulphides, and the subsequent erosion of the surface material from meteoric agencies. The Forest Queen basin of this kind is the largest I have ever seen. Now take into consideration the character of the country rock along this crevice; it is soft, friable and easily eroded, which would lead one to look for fragments of sandstone, metamorphosed to a quartzite in the vein material, also pieces of shale changed to a slate; both of these are found, and their breaking off has contributed to the surface enlargement of the fissure. It will not be surprising, as the workings gain depth, to

find fragments of coal with native silver attached in the crevice matter. I am confident there will be.

Now, having learned the structure of the fissure and the country rock, it is not surprising that several slips, slides and displacements of the ore bodies have occurred for a depth of sixty to 100 feet, and in large bodies, as the surrounding country rock was eroded to a greater or less extent along the vein or crevice in places. That in a vein of this width it would be reasonable to expect a good-pay ore body along each wall in place, and several ore streaks or stringers of large size will also be contained in the porphyry, and that the whole of the crevice material, after 300 feet in depth, will pay to treat by some method. In fact, it would require careful picking now to find rock that will not assay \$20 per ton.

Part of the above statement has already been proved to be true, and any one can see it now.

The present cross-cut in the north drift at tunnel level will prove the width of the crevice, and, which I believe from what I have seen, to be over 100 feet. It will also prove the existence of an east ore body which has never been seen in the lower workings, and which, I maintain in a crevice of this width ought to be there, and which exists in similar veins that I have examined in other parts of the State.

As depth is gained, from what I have learned of the surrounding country, between 600 and 1,000 feet the crevice will pass out of the sedimentary rocks into the true country rock—granite porphyry—here it may be expected the fissure will narrow, but with no diminution in quantity or quality of ore. The quality, I firmly believe, will increase, as in the change of country rock the gangue ought to change from silica to calc-spar. This will carry more native silver and silver glance than now shows, as well as the ruby silver holding its own.

This mine now shows more ore of high grade in silver than any other mine in the State. Mr. Dillingham told me after a visit here a few days ago, that he had seen more ruby silver together at once than in the whole of his experience before in purchasing ores. I can say the same, and I am assured that the showing now is far beyond what it was a few days ago. As I write I can look out of the door and see two lumps of ore of several hundred pounds weight, intended by Mr. Thompson for the Denver Exposition, full of ruby and native silver, and in such quantity as the bulk of mankind never saw before.

No man can compute the value of the future output of this mine, in this piece of ground 265x1,000 feet of surface and unknown depth. That a large percentage in value of the National debt will come out of this space I fully realize.

To the courtesy of the gentlemen here in charge I am under great obligations for the opportunity to examine and lay before my readers a description as above, of what I believe will prove to be the largest producing silver fissure vein now known in the State.

There is much more to be learned and said of the mines of this district, of which Irwin is the centre, and as I learn it I shall take pleasure in laying facts, as I know them personally, before my readers.

CHAPTER VI.

Elk Basin—Geology—Elk and Micawber Claim—Ruby
 Gulch—Oaks Claim—O-be-Joyful Gulch—A Peculiar
 Vein—Conglomerate—Anthracite Coals of
 Irwin—Flowers—Bituminous Coals of
 Ohio Creek—Lava Eruption—Castle
 Rocks—Gunnison City—Gypsum
 —Senator Hill's Ute Reserva-
 tion Bill—Natural Wealth
 of Irwin—Justice Basin
 —Redwell Basin—
 Peculiar Spring
 and Results,
 Etc., Etc.

IRWIN, Gunnison County, Colo., July 30.—It is just two weeks to-day since I mailed my letter, in which the Forest Queen was described. In that time I have traveled over considerable territory in this immediate neighborhood, seeing much that is good, but, of course, not meeting with mining properties showing the development of the mine named above, nor having indications of as large ore bodies. Even in this universally rich district the mines on development cannot all be Forest Queens.

I was very much interested in my first short trip, after my last letter, in visiting Elk basin, within three miles of Irwin, where I went under the guidance of Mr. T. Owen, who located the Elk lode claim and named the basin. The approach from Irwin is up past the Forest Queen, through the woods north, past a small lake, around by the Venango mine and Belmont Consolidated Company's work, then up the gulch with an easy ascent, until a height of 11,000 feet above sea level is reached, and you are in one of the representative mining localities that this region abounds in, viz: Elk basin. Here the geology of the territory is beauti-

fully illustrated, as surrounding in all directions is the real country rock, granite porphyry; except in the direction of the basin's outlet, nearly east, towering up several hundred feet high in places, some parts of it still covered with the strata of sedimentary rocks, building up higher still. These two kinds of illustrative rocks here, show the great depths of the gorges existing at one time among mountains of utterly barren eruptive rock, which shortly after forming must have been elevated above the waters. I cannot reason otherwise, from what appears to have occurred, but that this enormous eruption of granite porphyry took place at great depths in the ocean. Then at the feet of these rough, jagged crests, in quite shallow waters, commenced the building of the coal measures of this Crested Butte basin. The real foundation was not settled yet, but gradually and very slowly sank, making but slight changes at a time in shore depths, but each change of level is now distinctly drawn by the alternating strata of coal, shales, or sandstones, repeated many times. The territory occupied by this coal basin represents a local and limited area, as I can find no change made in the material used in building these sedimentary rocks until about 1,500 feet in thickness of these coal measure sediments had been deposited. Then came a change, showing that a larger area of surface was being acted upon; as here in Elk basin, for the first time in place, I found sandstone conglomerate at an elevation of 11,000 feet. I reasoned that the subsidence to this depth was confined to a limited area, as when this conglomerate appears, in addition to containing pebbles from the rocks near by, it also has in one horizon a beautiful red jasper pebble, very hard, but worn perfectly smooth, some of them quite small, showing that they had beat about a long time in the ocean's waters and traveled very much

farther than the other fragments associated with them. Here also with this conglomerate, in place, I found fragments of petrified woods. In one large piece the replacing material is iron instead of silica. It was here that I realized that the total depth of these sedimentary rocks now approaches 2,500 feet in thickness, building up over all of the mountains of granite porphyry to a total height that we cannot measure now, as doubtless very much has been eroded beyond what still remains.

After this came the fissuring of all of the rocks, which openings are now represented by true fissures, and containing the rich mineral of this section. Now, as the rocks would break along lines of greatest weakness, the strong veins followed the course of the original gorges to a great extent. This occurred in Elk basin, three large fissures opened parallel to each other, now named as the Micawber, Elk and Silver Deal mining claims; also many cross fissures occurred at the same time, and they too, carry pay ores as well as the larger crevices. This breaking or fissuring of the sedimentary rocks along the old gorges gave the start for the present courses of drainage and erosion.

Here, too, I believe is proved another fact, which has been held of late years, by leading geologists and mineralogists, viz.: That the contents of fissure veins are the accumulated atoms derived from the adjoining country rocks; because here I find where these strong veins outcrop in the conglomerate, the ore is of very much lower grade, with zinc and iron sulphides predominating; while on the same veins apparently, but worked at places where greater surface erosion has taken effect, such ores as ruby and native silver appear. Then again, where a vein is found in the granite porphyry, the gangue, is principally calc-spar instead of quartz.

Such evidence, as the facts just stated, would lead to the inference that the vein material would be modified

by each different strata of rock passed through, and show the change in the same horizon. It would be interesting to have careful chemical analysis of country rock and vein matter from the same horizons of some of the veins here, when the mines are regularly and systematically opened, so that one could select material and be sure of depth enough to pass all surface changes.

I wish to have my readers remember, and try to thoroughly impress on their minds, that what I say about this country is derived from the facts as I see them; that I am working in a formation, the like of which has never been described in any work on geology; therefore, in making deductions from these facts, they must not be taken as generalities, that will apply to other sections. This is the only real generality that I find everywhere, viz: Each locality must be worked up by itself, without reference to what appears to be similar elsewhere.

The Elk lode was the strongest vein that I saw in the basin, though I am told the Micawber is showing splendidly in development, but could not get into it on account of water in the workings. This Elk lode is, in places, twenty-five feet wide on the surface, some high grade ore has been got at grass roots, also in a forty-foot shaft a little ruby silver occurred; but the best showing is in recent work and only twelve feet from the surface. Here over three feet of ore is seen, evidently low grade, but for the reason given above, regarding change of quality with depth, is perfectly safe to go down on. Mr. T. Owen had taken two large pieces out at the time of my visit, aggregating 1,000 pounds weight. They are now in Denver as part of the Mining Exposition. Were there work enough being done in this basin, the cost for a wagon road would be comparatively small from any of the claims to Irwin. At present, however, all that I could learn of was, that assessment work was kept up.

The next place was up Ruby Gulch, to see the Oaks lode, recently leased and bonded by R. R. Duncan. I went there in company with W. E. Grover and T. H. Wheeler, the latter gentleman only three weeks from Boston and the sea coast. He appeared to take to mountain life as naturally as a duck to water. Pay ore was discovered at grass roots on this claim, and surface stripping was the work being done. The quartz-carrying mineral is from one to three feet wide. What this ore will average in value I cannot tell, but while I was on the ground three shots were put off in the mineral streak, and all of the rock thrown out contained a good showing of ruby and native silver. Mr. Duncan has sent a very handsome piece to the Exposition. One could not help but draw the conclusion that the Oaks mine from its surface showing has a real basis that will warrant development, and with careful management in time be a good paying property. I obtained some fine specimens here, one of them a real gem in mineralogy, a crystal of ruby silver inside of a crystal of quartz.

The next day, in company with two of the gentlemen named, I went into O-Be-Joyful basin, about eight miles from Crested Butte. A good wagon road grade is found all of the way up to the head of the basin from Slate River.

I saw one claim here that is a veritable curiosity in geology, or fissure vein filling. It is a true fissure and about 900 feet up the mountain side, a fine outcrop of galena shows for 160 feet along the surface, ranging in the surface outcrop from five to nine inches in width; the galena partly changed to anglesite, and of an average value of about \$60 per ton. The total height from the basin level to the top of the ridge, that this vein cuts through, is about 1,200 feet, and divides Poverty gulch from O-Be-Joyful basin. Some 400 feet below the mineral outcrop a tunnel has been run in 150 feet, on a fine crevice, but no

mineral shows as above. A little soft gouge occurs in places, but the crevice is principally filled with a material fallen in from the surface and shows a dry crevice. This was so strange that I set about finding a cause for it and climbed clear to the top of the ridge. From there looking down nearly 1,200 feet, very steep, over a snowbank, into the next gulch. On climbing up past the 160 feet of mineral showing named, the line of the crevice still appears to the top, but no indication of ore. On the crest, about twenty-five feet wide, I went 500 feet east and saw nothing that gave any clue to what had occurred, but in examining the surface west I found it. Here was, outcropping 300 feet wide, quartz porphyry, evidently the filling of an older fissure than those now worked for pay ore, and which existed previous to the forming of the sedimentary strata, which everywhere occurs here. Now we have it again, where the recent fissures occurred they followed lines of weakness in the country rock, and here were old fissures marked out, which easily opened. On the west side of this quartz porphyry is a very large recent fissure, filled to the top of the crest with crevice matter strongly mineralized. The conclusion in this case was obvious; the west fissure from some local cause not now visible, took the bulk of the crevice or vein-filling matter, and left the east crevice partly dry of any vein filling at all, and quite uncertain as to what results might be on development. It is a real curiosity in vein making, but fully illustrates the folly of laying out large plans for the working of a mine until after the ground within the boundaries of a claim, as well as all of the adjacent rocks have been examined thoroughly by some one who has made the formation of rocks and mineral veins a study, and whose experience would be able to point out the causes of what appears now as effect.

On this crest I found the conglomerate in place, the

same as in Elk basin, and the first locality to have it showing on the Slate River slope.

On the way back we stopped to look at the Spar Chief claim, which near the surface has eighteen inches of mineralized calc-spar, assaying from \$50 to \$2,000 per ton. One day is hardly enough for a basin like this, and I expect to go there again and find many good things—not developed mines, but opportunity to make them.

About one and a half miles from Irwin is the anthracite coal basin. For the last two years I had disputed the existence of real anthracite in Colorado, because no one could give me any evidences of changes in the neighboring rocks with the coal that would show the geological change from bituminous coal to anthracite. On seeing this ground I had to acknowledge that I was wrong, because I could see where and how the changes occurred. They have anthracite coal here, a four-foot vein of it, said by Pennsylvania experts to be equal to anything in the East; in fact, chemical analysis show an average of two per cent more fixed carbon than the best Lehigh Valley coals. It is being mined now for fuel to be used at the Pioneer mill, also for making the steam for power used in the mines here, as well as the local demand as a stove coal, for which purpose it never can be excelled in this State. The two railroads have graded—viz: the Denver & Rio Grande and the Denver & South Park—into this basin, and were it not that the officers of both of these corporations are extensively interested in coal lands personally elsewhere, I opine track would have been laid over these grades and Denver have the opportunity to use the finest stove coal in America. This city alone could use twenty cars per day. It could be sold there at a profit, with reasonable freight rates, and then be cheaper and much nicer than any fuel now used in Denver. These properties now being worked are owned by Mr. L. R. Thompson and associates, who have shipped

some fine pieces of this anthracite, which, when seen by Denver people at the Exposition, will cause them to wish they had it to use in their stoves, instead of the soft coal that slacks so readily, and dirties everything it comes in contact with, causing constant vexation and annoyance to the neat housekeeper.

The occurrence of this anthracite is very interesting geologically. Originally the coal strata laid flat, but in this section a small mountain range of granite-porphry, from some local cause, moved upwards, raising the strata resting on the flanks of the mountains until they now stand at an angle of 21° .

It was this movement of the adjoining rocks that gave the heat and pressure to make the change in the coals, from soft coal to an anthracite. Where the sedimentary strata broke, one of the drainage valleys of this section occurs, letting the surface waters out now through what is known as the South Fork of Anthracite Creek, and through that to the Gunnison River. The coal seam now opened has a splendid roof of solid sandstone; the inclination of the vein places it in excellent position to work, as it drains itself, and from levels run, it makes the coal in place, stopping ground, the same as a fissure vein, thus naturally giving the most economical facilities for working. Were this anthracite coal field of the same extent, comparatively, as the Eastern coal fields of like character, petroleum oils in paying quantities might be looked for and found in this neighborhood.

In comparing the position of the opened vein, I thought I saw evidences of its being in the same horizon as the vein of semi-bituminous coals opened at Crested Butte, and of the same thickness. If this evidence should in time prove to be correct, then between this opened vein of anthracite and the mountains east, there ought to be two more veins

of anthracite, and one of them approaching a thickness of eleven feet.

As will be seen further, on subsequent knowledge proves this deduction to be erroneous, from the fact that the coal measures here do not extend deep enough to allow these other two veins to exist.

Learning that there were large beds of semi-bituminous coal southeast of this last described locality, along the Ohio Creek, I embraced an opportunity of accompanying Mr. F. W. Fuller, on a horseback trip, to Gunnison City. Following the wagon road over the small dividing ridge that separates the heads of Ohio and Anthracite Creeks. As one approaches the coal measures again in place, the vegetation becomes very luxuriant. In one place of about fifty acres, I saw a natural flower garden by the road side that surpassed in variety and gorgeousness of colors, anything I have ever seen outside of ten acres of lilies I once beheld in bloom, in the grounds of a florist on Long Island, a short distance from New York City. It would be worth the while of some of those Eastern flower-growers to spend one or more seasons in this country; they would find very many new plants that they could make of practical use in their business.

We stopped for dinner at Mount Carbon, where the Denver & South Park Railroad people have extensive coal land locations, now being worked, and the coal delivered by wagon at Gunnison City. From here, in company with T. Owen, I made a side trip of a few hours' ride to see the result of some work that he had been doing as my agent. This ride would be a treat to a stockman, for I rode through miles of mountain grass that came up over my feet as I sat on horseback, plenty of water and timber, with coal underneath the whole of it. I rather think Owen tried to feel of my nerves; as we rode along he pointed out a place where he had shot a mountain lion a few days before. Nice in-

formation for a tenderfoot, only armed with a penknife. I hadn't lost any mountain lions and did not want to find any.

I found considerable work done on these coal locations. I went into one opening showing a seven-foot vein for 400 feet of drift, of excellent coal, and saw other openings on coal seams in place that led me to think there was at least three separate veins here now opened, with perhaps more to be found in depth.

This wagon road to Gunnison City is excellent. As we rode along I thought I could see where the coal basin formation ended on this east and southeast side, with the marked change in the boundary rocks.

On one of the hills north of Ohio Creek is an outcrop of recent lava, which must have had an enormous outflow (want to go to it next), evidences of which I had already seen in the gravels at Gunnison City. This volcanic eruption must have been one of the causes of the recent fissuring of this coal basin, so that the silver veins could occur through coal strata, an anomaly that I think does not occur elsewhere to be known on the face of the globe. South of Ohio Creek is a natural picture—castle rocks—which stand up many hundreds of feet in height, and is an exact representation on a huge scale of the pictures one sees illustrating ancient castles of the middle centuries of European civilization. Here I want to go also. One of my greatest desires now is to learn the area of this whole coal basin and see what the geology of its surrounding rocks is. I realize now that this area will represent one of the most marvelous sections, in many respects, of Colorado.

Ohio Creek flows southeast through a broad and evidently fertile valley, mostly taken up with stock ranches, fenced on the bottom lands, with the rising or hilly ground, extending back for miles from the creek, open, making a first-class grazing ground.

We arrived in Gunnison City about midnight and left the next day at noon, so that I had not time to learn much here personally. I saw some good building sandstone from near the city, now being used in the new bank building, also some gypsum, some of which had been burned making the whitest plaster I have ever seen, as well as samples of fire clay which was stated to exist in a bed nearly ten feet thick. If I did not see much, I heard of many things that I do want to see, and will make an opportunity to do so as soon as I can.

We returned to Irwin in good order, myself especially, with the feeling that I had seen and learned something. I was at this place the evening that the dispatch came saying Senator Hill's Ute Reservation bill had passed the House. Irwin, of course, broke loose, and the Senator's health was drank many a time and often. That bill means to this locality and people just what the original Declaration of Independence and peace meant to the men who first celebrated the Fourth of July, one hundred years ago. Now that President Arthur has signed the bill, this country is a part of the United States, instead of being relatively, as it has been for the last three years in the position of a foreign territory. That is the view that capitalists and investors have taken of this part of Gunnison County. Now that—thanks to the efforts of Senator Hill—this barrier is removed, and actual titles can be obtained to lands here, these people that have so patiently waited can go to work with renewed energy and confidence that the capital will come even on the showing that can be made this year. Its effect is to be seen already, as the Windsor House tables are full every meal, the Pioneer mill is running day and night, while on every hand one hears of new work started or about to be commenced.

I have already seen much of this section, and can frankly say that I have seen more evidences of natural

wealth, with fewer barren prospect lodes, than any section that I have seen of the older mining regions of the Eastern slope. This being an off-year in mine selling for Colorado, now is the time to buy prospects, especially with the showing that these have here, and at the prices and terms on which they can be purchased. With judicious selection, adding to them the work that can be done between now and spring, the man with a few thousand dollars to use can make many hundreds of per cent. profit in the next year or two. This is an easy country to work in, has advanced far enough to prove that there is an abundance of rich ores; it also has transportation near by to carry ores to market, as well as bring supplies in. In addition to which is the home cash market made by the Pioneer mill, and Messrs. Rose, Reed & Co., ore samplers and purchasers.

About three miles north of Irwin is Justice basin, elevation about 11,000 feet; can be made readily accessible by wagon road at small cost of money and labor. Up there I went in company with Messrs. H. C. Thompson and F. W. Fuller. Here only prospect and assessment work has been done. It is a duplicate, on a smaller scale, of Elk basin, but contains very large veins with good mineral showing near to the surface. We saw the Justice, Homestake, Alaska and Tacamah mining claims, any of which, when worked, ought to turn out large amounts of ore. In this basin I think the gorge was not so deep as in that of the Elk, the granite porphyry coming nearer to the surface and a less thickness of sedimentary rocks appearing. I do not consider that this will be found to be any detriment to the fissure veins, but rather a benefit, from the fact that the veins will sooner, as depth is gained in working, be found to pass within smooth solid walls, containing an easy gangue to work but holding their own in size of ore bodies as well as richness. The veins here showed surface croppings of ten to over fifty feet wide.

Hearing much regarding Redwell basin, about five miles from here, on the Slate River slope, I went over there a few days ago. The approach from Irwin is made through Elk basin, already described, up out of this basin, over a rapidly rising grassy slope of about 3,000 feet—top of the crest about 12,000 feet above sea level—and then—it took my breath away for a time—I found myself suddenly looking down to a depth of fully 1,000 feet into Redwell basin, with a spider line marked out along the side, ending just across a snow-bank from me, which, on examination, proved to be a trail. Having tied my horse where the grass was most abundant, and taken in my second wind, as well as getting my nerves steadied after the first surprise, I slid over that snow-bank and fetched up on the trail all right. It did seem for a few moments as if it would be an easy thing to expedite the descent and go head foremost down the side for 1,000 feet. However, following the trail was much the better way. As I neared the bottom I heard the sound of hammers on an anvil. There I went, finding Mr. A. S. Stover and partners encamped. They have taken up some good claims here, one especially, the Little Addie, in surface cut shows over seven feet of mineralized rock, and not across the vein jet. It is claimed to be the same vein as the Micawber, in Elk basin, and can be traced the whole way across the dividing ridge that I had just come down. Also saw the St. George, with a five foot crevice, and good solid ore in it. Stopped at the Rebecca; on which work is now being done, showing strong possibilities of good ore near by. From a claim known as the Boston, with an eighteen-inch mineral streak, I obtained good specimens near the grass roots; value per ton I do not know, as in most of these basins only prospect holes have as yet been worked.

About the middle of the basin a very strong ledge of iron stained quartz appears. Over this breaks a small

stream of fresh water, next to it a smaller stream, highly charged with sulphur, then another stream of fresh water, beyond which is the iron spring, from which the name Redwell is given to the basin. This spring is over ten feet deep, nearly twelve feet square, with waters so clear and pure that it seems as if you could pick stones off the bottom with your hand from the edge. The water contains so much iron that a rim of that material is built up around the spring as well as staining the whole of the rocks for hundreds of feet down the basin. The sulphur, fresh, and iron waters all mingle together, running onwards to the Slate River. Mr. Stover had kindly accompanied me that I might see and learn as much as possible in one day. I found his knowledge of localities of much value to me. From the spring we went down the basin, following the water-course in the bed of the stream. I saw the iron was being precipitated and cementing the loose stones into an iron conglomerate. I realized then that I was in one of Nature's workshops and was on the lookout for everything that was going on. We had not far to go, when we came to the croppings of a coal seam; just below that, in time past, was evidently a small basin. Into this basin the mingled iron and sulphur waters had poured, but the vegetable matter, taken up in solution from the coal seam, had acted as a precipitant, and here the manufacture of minerals had been and is still going on. For, in an excavation made into a flat deposit apparently, was large cubes of iron pyrites, with a fair showing of zinc and some galena.

Now, if my deductions of what I saw in this spot are correct, it is ahead of any laboratory experiments ever made, for here nature is doing the work and on a scale that is comprehensive. Further, if my reading is right, it is the most wonderful spot now known, for it shows how easily, quietly and perfectly nature does work, and, as one examines what is being done, the marvel is that the old

straining theories of fire to make minerals were ever held as tenable at all.

I spent just five hours in Redwell basin, and now feel that I saw and learned more in that space of time than I ever accomplished in a similar period of my life. It is a most interesting spot. I could spend days there and not tire of it.

As I read the notices in the *Republican* of the approaching meeting of the association of mining engineers in Denver, I cannot help but wish that I had the means personally to invite them into this country for a week or ten days, that they might enjoy it with me. What is to be seen that relates directly to their business is simply marvelous. Nowhere else in the world, that I ever read of, can rich silver veins be found breaking through recent coal measures, all to be seen and realized as occurring in place. They could learn more here, that is really new, in ten days, than in almost a life-time anywhere else that I know of.

The curiosity of it is not all; nowhere else have I seen a territory so naturally blocked out for the use of and active working by large corporations.

Everyone of these mountain basins contain veins worth working. If organized capitalists would secure single basins for their own use, at the prices that they can now be obtained at, with cash enough in hand for a couple of years development and expenses, I know places that can be made to pay dividends of one per cent. per month on \$3,000,000 to \$5,000,000 capitalization, and keep it up for years. It would not take so many thousands to do it, either.

CHAPTER VII.

Durango and Mexico Claims—Venango Properties— Comstock—Iron Basin—Silver Basin—Swan Basin—A Perilous Position.

Just after my last letter I had an opportunity to examine the Durango and Mexico mining claims of Ruby gulch, represented by Mr. Wilder as principal owner and active manager. These veins cross each other, and as the Mexico is much the stronger crevice, it holds its course across the Durango, the crevice material of both intermingling at the junction, but the ore body at this point really is governed by the course of the Mexico. The first-named has the most development, a tunnel having been run in past the intersection, good ore taken out up to the Mexico ore body and then lost. My examination showed that the miners had worked over and into the hanging wall, and if a cross-cut is now run for the foot wall, I am very certain a good, continuous ore-body will be found on that side of the crevice; as in this mine the foot-wall is the one that should carry the largest body of pay ore. The surface of this mine has good shipping ore all along past the junction of the two veins for some hundreds of feet, and there is nothing to indicate but that the same should continue below.

This mine is equipped with a neat little hoisting engine manufactured by Hendey & Meyer, of Denver. It is used for hoisting the rock from a shaft 100 feet deep. This shaft is sunk on the hanging wall, some good ore obtained but not the continuous ore-body that the foot-wall ought to show.

The crevice of the Durango is fully fifteen feet wide,

and in addition to the quartz carrying ore is filled with feldspathic porphyry, which I consider the best vein filling known, always finding it with strong and rich ore bodies.

Not much development has been done on the Mexico as yet; surface stripping is now going on, as they have \$100 ore for 700 feet along the vein out-crop, from twelve to eighteen inches wide. Its chances ought to be excellent for developing in time, into a first-class paying mine.

After this I examined the workings of a block of property (I have forgotten the name of the company), situated near Elk Creek, and managed by Mr. Copley. There is one principal vein—the Venango—and two cross lodes, the Souri and Tioga. Good ore was obtained by sinking in the Venango. This was left when tunneling was thought to be the order of the day. The opportunity for tunneling here is good, as considerable depth can be gained. A tunnel to cut the Venango, has been run 400 feet in solid rock, expensive dead work. When within fifty feet of the vein the work was turned at right angles, and has been continued 200 feet to catch the Tioga, and is now just upon the edge of it. There is something singular about such work as this, for here is at least \$20,000 expended in dead work on this property, that practically is not worth one dollar, from the fact that the tunnel starts within twenty feet of and parallel to the Souri vein.

Had the work of tunneling been done on either the Tioga or the Souri veins from the surface, the ground would have been developed to show what the veins contained, and the Venango could be worked all right from either point of intersection. Such work as I saw on these properties is evidence of gross mismanagement somewhere, and when I see money that is meant by the parties advancing it to do the most good, spent in this way, I cannot wonder at Eastern investors cursing mining as a losing business. Whose fault this is I do not know. I take

things as I see them and judge for myself. These people really have good properties, and it would make a practical mine manager ache all over in the desire to take hold of them and show the owners what they really have got. These veins are close upon the real country rock; are large crevices, and should soon pass within smooth, good walls, with an abundance of good shipping ore, besides an easy gangue to work, viz: calc-spar.

It was the calc-spar appearing in the lower workings of the Durango claim, mentioned above, that helped to give me such a firm belief that there is good ore below as well as on the surface of this vein, and will be found to hold its own in quality, especially if searched for the right side of the crevice. They are sacking some very fine ore in the surface stripping of this mine.

It was in the Venango claim that I first got copper pyrites, while among the ores of the Mexico claim a little copper stain appears.

The absence of both lead and copper in this Ruby mining district is something remarkable, as, of the ores produced, the average of galena is less than three per cent., and of copper less than one per cent. These facts alone, are sufficient for a thinking man, even if he does not know much about ore reduction practically; to realize that the way to do with these ores is to ship them to the larger smelters for treatment; the principle of ore reduction being to produce an artificial ore most economically from a combination of natural products; and from it in its turn the gold and silver can be easily separated. This being the fact, I do not believe that any known means of reduction can be applied to these Ruby District ores and be locally successful, but they must be shipped to smelters who are also purchasers of galena and copper ores; these latter making the best matte, or artificial ore product. In the smelting process it is by the judicious mingling of the high

grade gold or silver ore, with those containing a large percentage of either copper or galena that the greatest value of the first is saved. There is no quick process by which silver ores can be chlorodized, or made free milling; and I am certain the Pioneer mill of Irwin is proving this to be a fact, as they must be losing money on every ton of ore that they treat, and the mill will soon be an idle monument of Professor Jacob's ignorance.

The mill shut down October 1, 1882, and the manager published a statement that the loss was even thirty per cent., may other investors take warning.

To fully connect the geology of Ruby gulch with the other mineral basins, I must mention the Comstock, which is a very strong vein, the northwest extremity of one of the largest veins of the gulch. Only a ten-foot hole has been sunk, beside the granite-porphry hanging wall, with calc-spar already appearing and showing mineral. Twenty-five feet more ought to bring them into a good showing. The vein is a very large crevice, filled with feldsitic porphyry, strongly impregnated with oxide of manganese, also containing concentrated spots of ore in the surface float, showing what the crevice matter ought to be when depth is gained. As the vein breaks through the ridge that makes the divide between Ruby gulch and Iron and Silver basins, I climbed to the top of this ridge to examine the other side, and could not find that the same strength of crevice material appeared there. On searching for the cause of this, I found that the crest of the ridge was a strong mass of porphyry, and continuing on up to Ruby Peak. This probably cuts off the supply of mineral, and makes a very great difference in the value of the veins on the Anthracite Creek slope.

The basins along this Anthracite Creek were next in order for me to see. Finding T. Owen and a Mr. Berry were going to Iron basin, to do some assessment work, I

accompanied them. The route was up Ruby gulch, with fine grass-covered slopes to the east of Ruby Peak. From the top of the ridge, elevation, about 12,000 feet, a fine view of Peeler and O-be-Joyful basins is obtained. The trail skirts the rim of the last-named basin many hundred feet above the level parts of it. Part of the trail passes over large fragments of rock filling a deep rift in the mountain side, and underneath this a strong stream of water flows, giving one a peculiar sensation as he walks over it—the impression being that you are in the midst of a thunder storm, with the noise all about you, and the sun still shining brightly overhead. Then we crossed a snow-field of nearly 500 feet from there to the gap, where the descent is commenced on the other side the trail is really dangerous, known instances being authentically related of horses and “burros” having gone over the precipices. We had two loaded burros with us, and at one place where steps were cut in the rock, close to the precipice, the leading burro lost hold with his fore-feet and began to make motions for back somersaults. Once started, he would have made many of them; but, fortunately, the burro had on the catables, and Berry and Owen, realizing on the instant that something to eat was more convenient right there than 1,000 feet below, sprang forward in time to give the animal a boost that set him safely on his feet.

Down from the gap on the ridge, over quite a long but good trail, we passed into Silver basin. Here we found some men encamped who had a contract on a cross-cut tunnel; but they did not appear to be very well posted on the geography of the section, as I found that my companions had never been that route before, and could not learn anything from those whom we had just met. However, we knew where Iron basin ought to be, so we skirted the dividing ridge vainly, seeking for a trail; going through wet, marshy ground and brush, over fallen trees and rocks,

raining, too, to help out the misery, mosquitoes thicker at times than bees swarming, but finally arriving after nearly five hours' tramp, dinnerless, at the first claim to be worked. While the men were getting supper and putting up the tent, I set to work to examine the vein, extending down a rift in 500 feet of precipice.

I found that what, at that depth, appeared to be mineralized quartz and very strong vein matter, was in fact only country rock, iron stained from oxidization of pyrites contained in a very narrow streak of quartz. Up at the dividing ridge I looked, and there was the porphyry dike that I had seen when examining the Comstock, and this showed how well it had done its work, both for Iron and Silver basins.

As I climbed back up the 500 feet I had just come down, I found that in many places the rocks leaned the wrong way, so that I had to exert myself to the utmost to get up, as well as to keep from falling. On arriving at the tent I was, from over-exertion, trembling like an aspen leaf. However, a good, hearty supper and a restful sleep made all right, so that I was off by sunrise the next morning. Taking my own course, I went up a grassy slope, and down a similar one on the other side, and I was in Silver basin in less than one hour, that had taken nearly five hours to go round from the day before.

I looked at some of the holes in Silver basin, but finding that they were apparently governed by the same influences as in Iron basin, it did not seem to me that any quantity of pay ore could ever be got, no matter how much work might be done.

This being the case I hurried along to Swan basin, starting up a couple of mountain grouse on the road, the nearest approach I saw to game anywhere.

At 8 A. M. I was in Swan basin, eight miles from Irwin. As I came down the trail into this basin—a small

one, but beautifully located—I saw that there was a radical change in things, and something new had come in as a governing influence.

I visited some sixteen claims with strong veins from five to ten feet wide, finding an entire change in the character of quartz filling the crevices, and the mineralizing element being principally arsenical iron pyrites, the quartz having the appearance of gold quartz; and knowing that gold, arsenic, iron and sulphur make one of the strong combinations for that precious metal, I immediately began a search amongst the oxidized pyrites for free gold, and found a little. The next move was to find a cause of such a change in the whole of the mineral showing, for it was very evident to me that if any of these veins are worked down to pay ore the product would be gold, while the prospectors were looking for silver.

After some search I found the rock that does the whole business—a large outcrop of Archæan granite in place, with the granite porphyry flowing over it, and the sedimentary strata built up against both. Now, when the veins are worked down into this kind of country rock, the ores produced ought to be tellurides, the same as in Boulder County. In fact, on the Little Indian claim, owned by Swan Bros., I was shown some dark looking streaks in the quartz produced, and from such as this they claimed to have different test assays of 200 ounces in gold per ton. These dark streaks have all of the appearance of a telluride ore, and depth may prove them to be the upper parts of petzite streaks and very rich.

This basin not having produced any surface shipping ore, and all of the quartz containing arsenical iron pyrites up to the grass roots, it is impossible to say, with the present developments, that they will be paying veins, even at reasonable depths.

There is nothing proved and nothing in this part of

the country to compare them with. Personally I have the highest opinion of what I saw here, but work must be done to prove that these veins enclose ore that contains profitable pay; and I most earnestly advise the owners of these claims to go down upon them at the lowest surface places that they can find to work to advantage.

I have had the pleasure of dining with Mr. and Mrs. Stevens, who are occupying a new and comfortable log cabin. They are the owners of some of the best of the prospects in the basin; and Mrs. Stevens, who came over from Irwin the day before I did, has the honor of being the first white lady in that part of the country, and certainly is entitled to the credit of displaying great courage and nerve in coming over the trail that she did.

Mineral and Kansas basins make up the remaining two on the north fork of Anthracite Creek. As I had found a gold-bearing sections which may prove to be very rich in time, and in such close proximity to a very rich silver district, I was anxious to see more of it. I could not help but connect the primitive granite found on the dividing crest of Poverty gulch with what I found here, and it ought to underlie both of these last-named basins, governing the character of ores accordingly. Having but three hours to spare, after making some inquiries, I started for a short cut over the dividing ridge from Swan basin. This ridge is about 600 feet high, and where I attempted to pass is built up of sedimentary strata, held in place by two large cross-dykes of porphyry, about 1,000 feet apart. The climb was very steep from the bottom up; the last fifty feet was as steep as the roof of a house, covered with a couple of inches of loose shale, not giving any secure foothold. Up this I scrambled like a cat, and then lay down faint and sick, for I was looking straight down 800 feet into Mineral basin, from a ridge only five or six feet wide, and no chance of getting there except by one jump.

As I looked back my head swam, for it appeared as steep where I came up, and to return that way was impossible, unless I wished to arrive at the bottom in a condition that would not realize much practically of things pertaining to this mundane sphere.

After a time my head cleared somewhat, so that I could see that Mineral basin was much larger than Swan, and from some indications that I could make out, might have a little better chance for surface pay ore.

The next move was to get down. After moving backwards and forwards several times, to accustom myself to the place, and motion on such a narrow ledge, I finally crept, on my hands and knees, to one of the porphyry ledges named. Holding to the projecting points of this, that I might not slide away from myself, I gradually slid down for 300 feet to a jumping off place of fifteen or twenty feet high. Here, fortunately, a spruce tree was growing, and by the aid of it I clambered down to terra firma, and thankful to have got around safely. Concluding that this part of the country would not get out of the hands of the prospectors for some time yet, I packed up to return, leaving the other basins for future years.

As I started I came across a party more tired and worn out as well as older than myself. To him I gave the use of my horse, when it was practicable to ride, and on top of the hardest trip I have had yet, I footed it eight miles into Irwin; but not at all sorry that I had been and seen what is herein described.

CHAPTER VIII.

Anthracite Range and Other Mountains—Description of Coal Measures—Story of a Pebble—Cochetopa Gold Belt—Lubricator Mine—Gage's Camp — Volcanic Ashes — Physical Appearance of the Gold Belt— What Ought to be Looked For — Gypsum.

IRVIN, Aug. 26, 1882.—Since writing my last letter, appearing in your paper, (*Denver Republican*) on the 20th inst., I have been too busy to do any writing; am away behind with my notes; and really beginning to be afraid that snow will come before I can get the section, north and east of the Slate River, examined; that I may fit its geology on to what I have already done.

However, to connect my recent observations, with the last recorded, I must commence with the Anthracite range, where I camped two days to examine the Anthracite coal-beds; and to try and find out, how it was that only about 2,000 acres of the finest Anthracite coal on the continent should occur here in a little locality, and be surrounded with such a wide extent of bituminous and semi-bituminous coals, and all of the same age and geological horizons.

The Anthracite range is something over six miles in length, stands nearly east and west, and composed of granite-porphry. Further west, single peaks of the same material stand up, known as Mts. Edgely, Beckwith and Marcellina; filling the gap to another mass of granite-porphry, known as Ragged mountains, and here the Elk Mountain range joins on. From the east of the Anthracite range, after passing a gap, this eruptive granite makes

another short mountain range,—the Wheatstone group—to the south of which stands Mt. Carbon. The Wheatstone group makes the connection through to the Slate River, dividing the coal basin of Crested Butte from that of Ohio Creek on the south. The coal measures build around, and upon the sides of Mt. Carbon. I am thus particular in locating these mountains, that I may more plainly show what has occurred.

Beyond the Wheatstone group, and on the Divide between East River and Ohio Creek is the large outcrop of recent lava, covering both slopes with detritus down to each stream.

When I had climbed to the top of Anthracite range, so that I could see all of this described country; I found the slope gradual towards the north, but very abrupt, and approximating 2,500 feet down to Ohio Creek, on the south.

Rising up from a forest of pines, was the Castle Rocks but how different in appearance, now that I was above them, and seeing them from a different position than the Ohio Creek road. Instead of the massive front showing there, with its battlements, towers, and turrets, here it had the appearance of a sham, or castle of cards, perhaps a better simile would be, that it appeared as a stage representation of a castle.

Standing on top of this range and looking east to the place where this volcanic eruption occurred, on the east border of this tertiary coal basin, I could see that a large crevice or gorge had opened from that westward; passing north of Mt. Carbon but striking the end of Anthracite range. Opening a gorge into that, and setting off a portion of it, as a mountain north. This effect can only be realized from the places where on I stood.

Now the conclusion must not be jumped to that I am describing the result of any sudden action, or quick move-

ment of the rocks for I cannot realize that such action occurred. The movement was slow, but the result of a vastly powerful force, making this fragment of a mountain range, move slowly northward, until the sedimentary rocks lying on the north base, were crowded so against, that they gradually slid upwards, against the pressure of the granite-porphyry, until they now stand at an angle of 21° as described in a former chapter. This movement must have been slow, or the sedimentary rocks would have been crushed into innumerable fragments, and subsequent eroding agencies would have cleared away the whole of what remains to-day of the coal measures. Now we have locally 2,000 acres of these rocks moved from horizontal strata to the inclination given, the heat and pressure generated by this rock movement, metamorphosed these originally bituminous coals, to the finest lot of anthracite now known. This 2,000 acres is all I can find of it in this part of the basin, and I feel very certain that I have correctly described the manner of its occurrence.

As I came down the side of the Anthracite range, I picked up a couple of red jasper pebbles, sole remnants of over 1,000 feet of tertiary conglomerate that formerly covered the upper part of the sides, and over the top of this granite-porphyry range.

Could these pebbles talk what a history they could relate; they could tell of their early life and residence; how at one time they jutted out, the portion of a large whole, on some mountain side; how below them was swift running waters; how the mountain top was snow-capped; how the frosts split and set loose large fragments of the formations above them; how one of these crashing and tumbling down the mountain side, broke off fragments of this jasper; how as sharp cornered, angular stones, these pebbles formed part of the detritus of the mountain side; how the swift running waters at the mountain foot, kept

clearing away the masses below, so that each season found them nearer and nearer to these waters; how slow this part of the journey was, compared to the traveling that followed when they reached this madly rushing mountain stream; how after a time, into these waters they fell, and commenced their journey seaward; how in this journey they were knocked against other rocks, all rolling through an unknown country to an unknown end; how here a corner was chipped off, there a rough spot ground smooth; how they gradually diminished in size under nature's rough handling, until from many pounds weight, a few ounces would out-balance them; how at last, they, with many others, reached a sea shore; was there caught up in the waves on a shallow beach and thrown hither and thither with the crowd, rubbing and jostling against each other still wearing, on the sands, smoother and smaller; how they gradually worked their way by ocean's currents to deeper waters, and there had the rest their long wearisome journey entitled them to; how in this sea was no animal life utilizing its waters; how the waters of this ocean also received floating masses of wood from the streams coursing through its border land covered with the trees of the tropics; how these went their weary course hither and yon, never resting except as they rotted and sunk; how these woods revenged themselves on what was their master, for as a particle of wood left the larger whole it took from these waters an atom of silica; how this atom of silica attached itself to the woody mass, and so the exchange went on until what was once a portion of a growing tree, became a stone still retaining its identity in form, but nevertheless was stone and stone only; how this teaches that nature uses what she has at hand for her purposes; how these petrified woods helped also to make the sea bottom; how all of these changes were ages upon ages going on; how these same pebbles were buried hundreds of feet

deep by the material brought from the lands, by swift running fresh waters, to this hungry maw, that never could seem to be satisfied; how a seemingly endless time passed in this grave, never expecting to meet fresh waters again, nor see that bright sun which had daily shown on them in the long gone times; how there came a change, a gradual upward movement, and with it the rending of rocks, strange sounds, and the waters gradually draining out from among them as a mass; how another long, long period of rest followed; how after a time they again heard the mad whirling of waters, but this time above, instead of below them; how these waters appeared, in their rage and spite, to be tearing away all that had been so long building, getting nearer and nearer to them; how at last they too were caught in its rough swirl, but only for a short time. So hard did these new waters work that, in far less space of time, all that had been so laboriously accumulated, was again torn from their last home, and swept away, where to, these pebbles know not, how quickly these waters got below them again; how they, with a very few others, were left stranded upon the mountain side to wonder what had become of the millions upon millions of their fellows; how the sun shone upon this mountain; how in one season the frost attacked its barren sides, at another season warm showers fell upon the frost detached atoms; how after a time the green plant life came to them; how this lived and died year after year, adding by its death new elements to the rock dust, which each year became stronger to do that which nature wanted, that is, give support to more and more life; how at last another character of life appeared, that could move about, animals of all kinds, with two feet and four, clawed or hoofed; with birds among all that at times disdained the ground and flew hither and thither; how, strangest of all, one bright sunny day one of a new kind of animal passed them by, stopped and came to them, gathered them up, sent them to his

museum in Denver; how this being tried to write their story, in a few short pages, when the largest library could not contain the volumes that could be filled with all they might say of their old, old, story.

Such is a faint sketch of what these two insignificant stones might tell us of, could they only talk.

From this locality across to Jack's Cabin, or Howville on the Slate River, to be sure of the connecting links in the rocks that I have been trying to study and describe, was the next trip.

Then I had to go to Denver on some business needing immediate attention, was kept there only three days, when back I came to Gunnison City; at this place I was detained some days during the culmination of matters of personal interest, and took the opportunity to practically examine the Cochetopa gold belt, south and southwest of Gunnison.

The rocks of this belt appear to be Archæan granite, showing an average surface of ten miles wide and thirty-five miles in length, or an area of 350 square miles, and only prospected in places and evidently not at all in the best parts of it. Gold was first discovered, on August 5, 1880, in the Lubricator claim and considerable excitement occasioned, which rapidly died out, as the most of the discoveries were made in a trachyte formation that I found bordering each side of the granite belt; in some place this trachyte gives way to the older metamorphic rocks.

In this trachyte the veins have all of the appearance of gash veins filled with a very hard white quartz, occasionally containing remarkably fine specimens of free gold, just sufficient to lead the prospector on, but do not appear to carry their value as depth is gained. In fact, all of those that I saw, with but one or two exceptions, invariably pinched out a few feet from the surface. This trachyte country rock the prospector wants to avoid.

About six miles from Gunnison City is Gage's camp,

near here some of the finest gold specimens have been obtained. A short distance from this camp, bedded upon the country rock, is a large deposit of white volcanic ash, loosely cemented to a rock with a small percentage of lime. It is very interesting, as it contains angular fragments of country rock, which must have been ejected by the volcano while active, at the same time as the ashes. This eruption must have been very strong and continuous for a time, as the ashes fell thick and fast enough to fill the waters to an amount, which made the whole a thick mud, resulting in a homogenous mass of volcanic ash rock now very friable.

Had the eruption of ashes been lighter, or intermittent, the result would have been that the sedimentary material would have been washed and sifted by the waves, leaving horizontal strata instead of the present homogenous mass.

This ash bed also has another peculiarity, within it is found egg-shaped geodes from an inch or two in diameter, to one I saw of fifteen inches longest diameter, and nine inches through the thickest part of the short diameter of the oval. These are evidently the linings by infiltration of cavities in the rock, formed by the removal of some easily decomposed substances buried in the ashes, but what, I do not know.

I spent three days in this section, the last day riding some forty miles with three others, one of the gentlemen being Judge D. L. Murdock, of Fairbury, Illinois.

The whole country is covered with sage brush, and for game has an abundance of sage hens. It is most desolate in appearance, looking like an old worn out country, and such it really is. The monotonous appearance of the Colorado Divide, south of Denver, being the nearest to it for comparison of any section that I have examined. But its mineral wealth may turn out to be something wonderful. I certainly saw one or two evidences of what may be,

and as it is my business in this work to give information that may be of value to mining men, whether I get any immediate returns or not; I feel very much like placing myself on record as to this section by outlining what ought to be found.

The best veins will be found in the granite itself, and will show a true crevice of five to ten feet, or even wider; filled with a gangue composed principally of feldspar, at times a little lime, and occasionally streaks or spots of white quartz. This gangue would be originally filled with arsenical iron pyrites rich in gold, now decomposed or oxidized leaving the ore product free milling, and a value can be expected of from \$15.00 per ton upwards. This vein material will be almost picking ground for many feet down, and the entire mass filled with gold finely but evenly distributed. The depth of free milling ore will be from 300 to 1,000 feet. This estimate is based upon the fact, that this section has no springs or running water and the consequent decomposition of the arsenical iron pyrites down to the real water level of this section which will vary as above estimated.

The finding of rich specimen pieces of gold in such veins will be the exception; in fact gold visible to the eye may hardly be expected, but it will show readily enough in panning or testing in a horn.

Now such veins as these would naturally erode on the surface, leaving a trough or sag along the course of the vein, into which would be washed small boulders, pebbles and sand; covering all evidences of any vein at all. As no white quartz is in these veins of any amount, there will be no float abundant on the surface near them, as seen in the gash veins appearing in the bordering trachyte. Consequently the best veins and the only ones to be relied on for continuous pay, will be more difficult to find and will

have to be prospected for in a manner very different from the finding of most mineral veins. •

That this granite has been very much fissured, so as to allow such veins to form, there is abundance of evidence in the surrounding eruptive rocks, showing so near by. In fact I know that such has been the case for I found a large dike of an eruptive, porphyritic paste, which only occurs in fissured granite country rock; and where encountered before, there is an abundance of free gold to be had.

I feel almost certain that in time many such veins as I have described will be found in this 350 square miles of gold territory.

The above are the deductions I have made regarding this section as a geologist, and I know that I am right; may those who can take advantage of the knowledge I am able to give, and prove that I have read these rocks aright, and the result be of profit to themselves as a reward of their labors and faith in what I have said.

I might go one step farther and add, that if there is any geological section of Colorado, where there is a possibility of finding those rarer metals, known as Osmiridium, Palladium and Platinum, it would be in connection with the ores produced from such a locality as this Cochetopa gold belt.

In this granite formation and near to Gunnison is also found large deposits of gypsum (sulphate of lime), making, when calcined the finest plaster of Paris I know, as it has a brilliant white lustre equal to zinc white when used as a paint.

To this point was as far as I had time to put my notes in order, and make them public through the *Denver Republican*. Winter was coming, I had much work yet to do and I could not take the time to write, therefore what follows in this volume has never before been published.

CHAPTER IX.

Coal Creek and Redwell Basin Divide—Snow—Cause
of Iron Swamp and Iron Spring—Leaving Irwin
—Peculiarities of the Ruby Silver Belt
Prospective Product of Ores—
Concentration—Specimens
Collected.

On my return to Irwin, I was called upon to examine certain claims situated on the dividing ridge between Coal Creek and Redwell basin, about three miles from Crested Butte.

The route from Irwin was up through Elk basin, by trail around to the Coal Creek side, and into Coon basin. I found a large vein, twenty-five feet between walls, with a body of mineralized quartz, three to six feet wide, containing, originally, iron pyrites, now oxidized and leaving most brilliant colors of irrisdescent iron in the surface material. The owners claimed as high as \$50 in gold per ton, for this quartz; it certainly appeared to be a gold quartz. Unfortunately at the time of my visit there was not development enough done to prove anything further than that here was one of the very strong veins of the section, and well worth an expenditure of cash and labor to develop it. I climbed up to the dividing crest, and had a most noble view, Redwell basin, I could look down into, also O-be-Joyfull, up the valley of the Slate, over into Washington gulch, out and beyond Gothic and Crested Butte mountains; down Coal Creek, past Crested Butte town, down the valley of the Slate, in and amongst the Wheatstone group, over the points of Wheatstone and Anthracite ranges to the great Uncompahgre range beyond.

It snowed (August 24, 1882), a few minutes, while we were up there.

I saw something else, of more personal interest to me, than the above described, magnificent panorama. I saw that I had been examining the vein, which crossed Redwell basin, and from which is leached the material contained in the iron spring, and produces the other curious results described in my visit to Redwell. I saw that this same vein came through to the Coal Creek side, and here, by leaching, it furnishes the material for the bog iron ore of the iron swamp, on Irwin and Crested Butte road.

Seeing these results the question naturally arose, was not this vein of greater age than the other veins of the same locality, which carry the ruby silver ores? I think it is, and actually existed as a fissure vein, well mineralized before the commencement of the deposit of the tertiary rocks amongst which it occurs, and that subsequent erosion has again exposed it to view. The fact of its containing a gold value, instead of silver, is another local anomaly and would induce the belief that its source of supply here is from primitive granite, and that this country rock at this spot is quite near by. If future working should prove these surmises to be correct, and I feel quite sure that they are, the probabilities will be that here is one of the future bonanzas. It is worth trying, I could assure the owners of that.

Having spent more weeks than I at first thought, I would have to stop days in this Ruby Mining District; and, feeling that if any one had seen it thoroughly I certainly had, it was time for me to be moving, as I had very much yet to do before my season's work as I laid it out, would be accomplished.

Before leaving Irwin, where I met very many pleasant people, I would like to say a few words regarding its possible future, especially as it appears to have been very

much misunderstood as a mining district, and in some instances perhaps willfully misrepresented.

Its geological structure, as a whole, I must leave until I get through my season's work, that I may have all the real knowledge possible, in order to make correct deductions, and show without error, how it was possible for rich silver veins to occur breaking through tertiary rocks and in some instances passing up through coal veins.

Such is the anomaly of this ruby-silver belt, and it is no wonder that errors have been made in mining, and owner of properties threw up their holdings, disgusted and discouraged; but all did not, some held on and worked, partly because of a bull-dog tenacity that sometimes makes or ruins a man; others because they could not but reason, that if such rich *sulphide* ores were to be found at grass-roots, the ores must keep on down—Prof. Jacobs to the contrary notwithstanding—so that at the time of my visit things were looking better than they had for nearly two years. Mines enough were opened and proved to warrant an estimate, that if all that had been proved were worked, and worked as mines should be, a daily output would be had of 300 tons; worth, on an average \$75 per ton of shipping ore, or \$22,500 gross value per day. To accomplish this, such mines can be named as the Forest Queen, Bullion King, Buby Chief, Howard Extension, and four more claims in the Ruby Chief group, as well as the Mexico, Durango and Lead Chief.

In addition to this grade of ore, I never knew a mine yet, producing pay ore, but also yielded three to five times as much in tons of a concentrating product. Supposing we figure the minimum amount, and we have 900 tons per day of concentrating ore. This character of gangue, with mineral, will reduce ten to thirty tons to one, an average would be twenty tons to one, making forty-five tons per day, additional of shipping ore. These concentrates

would average \$200 per ton, or a gross shipping value of \$9,000, making a total product per day of \$31,500.

This is not an over-estimate at all, in fact, I think some of those locally interested will say I am considerably below the mark. This, however, I felt I had obtained sufficient data for, and that a very short time, say two years, would actually show an excess over my figures, for there is very many more prospects to be developed into mines, within a radius of three miles of Irwin, and which prospects show just as good at the surface as most of those that I have named, it is only a question of practical knowledge and work.

It obtained, personally, nearly 1,000 lbs. of the geological and mineralogical representations of this district, perhaps a better representation than has ever before been collected for practical use, by anyone to have them all together, that the relation of the different rocks may be seen in connection with the various ores, which occur in these mineral veins. There is no doubt in my mind, but that I have actually obtained sufficient data and evidences, to prove the actual age of these ruby silver veins, and that when I come to sum up the whole, they will be found to have occurred at a more recent date in the geological history of the world than has been before supposed, and very much later than the occurrence of most vein formations.

CHAPTER X.

Return to Crested Butte—Mining Claims in O-Be-Joyful Basin—How Knowledge is Needed—Work Required to Obtain Practical Knowledge—Geology of O-Be-Joyful Basin—North Fork of Anthracite Creek—Silver King and Bay Billy Claims—Fossils—A Hard Day's Work—Elko—Gothic Road—Bellevue Mt.—Central Mining and Milling Co—Crested Butte Again.

On August 26, 1882, I returned to Crested Butte, and the Elk Mountain House, to make that point the starting place again of future work. I was called upon almost at once to examine some ten prospects that had been located and a little worked by an Eastern company. We were off the next morning early for a long day's work, as these claims were scattered along the course of O-Be-Joyful gulch, and while it does not take long to decide upon a prospect hole, after the surrounding country rocks comprising the geological formation is learned, still ten for one day's work—Sunday at that—was considerable. I am thankful to say they turned out a little better than the average of such groups, as six of them showed evidences enough to prosecute work upon further, and only four utterly worthless.

A circumstance occurred between myself and the superintendent of the property, which I cannot help relating, as it illustrates one of the phases of mining, and how prone men are to lead themselves astray. Amongst the last claims seen, was one situated very high up on the mountain top, entailing a climb of some 1,200 feet up, to see where the discovery was made and the work done. I

was taken to an opening on another claim at the foot of the hill, from which some high assays had been obtained, and informed that as the claim I was to report on was the extension on the same vein, I could use what I saw here as the basis of a report. I looked at the dump and then enquired if "they were interested in this property."

"No we are not, but ours is just the same as this."

"Well" I replied "I only know in this kind of work "the ground that I actually examine. I am going up to "your claim and expect you to come with me."

"All right" he said, "but it is a very hard climb."

"That makes no difference to me."

We started having a good trail two-thirds of the way, and the rest—until a trail is made—would bother a "burro." Arrived at the discovery shaft I found a well mineralized true fissure vein, and a showing that caused me to say, "this is not the same vein as that where we stopped."

I saw my man's face elongate as he replied:

"Why we always thought so, it seems to be the same "course, and since they have obtained such good assays, we "have thought this to be one of our best properties."

"So it is" I replied "barring its present inaccessibility, "it is very much better than the one below, for here you "have twelve inches of gold quartz, well enough mineral- "ized to be pay if there was a stamp mill near by."

"Ah!" said he, "I remember now, two years ago I "had an assay of \$40 per ton in gold from near the top; "but all of this country carries silver, so I did not believe "that the returns were right."

"They were right" I said, "and here is the reason, on "the other side of this mountain or ridge is Swan basin, "the country rock changes there and the fissures carry gold "ores, the same country rock must come under this ridge "to this side, and the crevice of this claim reaches down "into it. It is from that rock that your vein filling and ore

"supply comes, and if I am correct we can get further proof, as we go down the mountain we will follow the outcrop, and as the erosion allows us to get deeper down on the vein formation it will probably widen and there is a possibility of finding a telluride quartz with this vein."

About 700 feet down we found where the vein widened to over ten feet between walls, and I obtained some nice quartz specimens showing the presence of tellurium.

With this result my party was well satisfied; but supposing I had taken his word that the vein below was the same as the one belonging to this company, as another expert did who followed me a few weeks after, and endorsed my report throughout except this claim, and stated that he did not understand how I could call that gold bearing quartz; but he did not tell the party to whom the report was made that he did not take the trouble to climb up and actually examine their claim, but accepted the statement that the claim at the foot of the hill was identical with the one he should have seen.

The gangue in this lower claim is calc-spar with a little galena and some fine particles of gray copper that runs high and is, of course, a silver bearing vein; but has no more to do with the vein on the mountain top than if it was a fissure filled with blue mud.

We cannot be too careful and painstaking in this kind of work; very frequently there is the expenditure of many thousands of dollars and perhaps the probity and honor of a mining company's officers, depending on the statement made by an expert. With such weights in the balance of careful or careless work, it seems to me always best to climb the hill, even if it happens to be three times 1,200 feet, than to allow a chance for error.

The men in actual charge of properties do not have the opportunity for a practical knowledge by comparison over large tracts of country, and many different mining sections,

the same as men following the professional part of the trade; and very frequently, as was the case here, the superintendent honestly believed that their vein was the same as the other, *merely because a line could be drawn between two points*, and knew nothing about the difference in the rock formations, which really would govern the character of ores even if the crevices were the same, which I very much doubt, as the course taken from the top of the hill carries the gold vein several hundred feet away from the one containing the calc-spar.

It is such facts as the above and those recorded in previous chapters, isolated instances though they are, that are the keynotes to geological sections, and enables one afterwards to fit the different points together into one harmonious whole, and reason out the structure of very many square miles of rocks; and I can assure my readers that it is no child's play, but requires years of toil, close study of what others have done, and constant practice, never losing sight of the principles of—shall I say—world making, and carefully working out each locality by itself upon such principles. Avoiding, of all things, being biased, or having your judgment warped by the knowledge of some other section that you are already perfectly familiar with, and be inclined to try and force the present to what you knew before.

It is this that causes more loss in mining than anything else, aside from out and out rascality, and why so many mining men successful in one part of the country, which they had to thoroughly understand to start with, fail, and miserably fail when they change to a new mining section.

I hope this kind of preaching will do some practical good; these are facts that cannot be stated too often or too forcibly for the good of all concerned; as what is for the good of the individual is for the good of the community, the good of the community is the good of the State, the

good of the State results in benefit to the nation, and nations make the world.

There is not much more to be said about O-be-Joyful basin, as prospectors appear to be bothered with what they find, and do not push work. There is primitive and eruptive granites, there is cretaceous quartzites and slates, with tertiary sandstones, shales and conglomerate, all having mineral veins breaking through them, and the ores governed by the country rocks through which they pass. All of this in a space of three miles square, it is not to be wondered at that prospectors become mixed, to say nothing about a mine expert fresh from Boston.

We were back to the hotel at 10 P. M., to learn that there was a call for a longer, and what proved to be a harder trip early next day.

This morning found three of us on the road, with the head of the North Fork of Anthracite Creek as the destination. The route was up Slate River to Pittsburg, hence up Poverty gulch, to the dividing ridge, near the "Little Nell" mining claim, and which route and locality was partially described in a former chapter.

From the crest we had a very steep trail to descend, made zig-zag down an eroded gully on the mountain side, not making more than twenty-five feet descent on each turn, for nearly 800 feet down.

The country was new to me, and to our guide also, as we found out; but all things, mining business as well as others must have a "first time;" within half a mile of the prospects the trail—such as it was—ended, as far as the use of our horses were concerned. I had an excellent one, light weight, quick as a cat, good for trails, speedy when necessary, and withal gentle as a house pet. Fanny and I had many a climb afterwards, and she never refused to follow anywhere, I led.

After leaving the horses we soon lost the trail entirely

and divided to try and find the property, I taking the upper side or mountain top, that I might have all of the view possible.

I saw the workings on the claims first and from where I was could direct the others to it and soon was on the ground of the Silver King claim also. A couple of years' assessment work comprised the development, made to show the most by having an open cut on the hill side, and exposing the ore body three to four feet wide, principally composed of galena. Some carbonates also, resulting from oxidization of the sulphides, and with a calc-spar gangue. This ore stood up twelve feet on each side of the opening, while the surface showed galena croppings forty feet northwest and 250 feet southwest, with a continuation on the surface of 150 feet more of vein material. The outcrop is in cretaceous shale, and it was on this mountain side that I first obtained any evidences of fossils, here finding casts of the fossil shell-fish *Inoceramus*. This shale had been partially changed to a slate by metamorphism, afterwards I found the granite showing further down the mountain.

The Silver King made a much better showing for the amount of work done than I anticipated, and when properly developed ought to be one of the regular producing mines of the section, with a surprise ahead for the owners as depth is gained; for the ores will certainly increase in quality and character, soon after depth is made below the shale, and where the vein enters the granite.

Five hundred feet below the "Silver King" is the "Bay Billy" mining claim which shows outcrops of six to eight feet of calc-spar well mineralized, carrying a value across the vein of \$22 per ton, an excellent ore to mine and concentrate; test on the latter gave by a crude process over \$160 per ton. In practical work this ore ought to concentrate ten tons into one and have a milling value of over \$200 per ton. These are prospectively more valuable

properties than the surface material shows, owing to the near proximity of a better country rock, into which the veins must pass. It is only a question of practical intelligent work to make these properties of large producing value.

Since my visit good trails have been made and additional work shows the property ahead already of what I intimated in my report.

Examining these Silver King and Bay Billy mining claims resulted in being the hardest trip that I made the whole season, as having missed the trail coming we did not find it going out. I struck out for where I thought it ought to be and fetched up at the head of a rift in the mountain, standing on a narrow ledge that I could not turn around on; I did not have hands and feet enough, being loaded with some forty pounds of mine samples and country rock. Below me was the rift running down 800 feet, filled with small stones, and an eight-foot jump into it. There was no help for it I had to jump and alighted upright starting an avalanche of small rocks, in company with which I went down that 800 feet in less than two minutes. As I neared the bottom, I thought it looked as if the rift suddenly ended, and was fortunate enough to catch a small pine branch and work onto solid rock in time to look down forty feet straight. Over this small precipice, tons of loose stones were pouring that my rapid descent had put in motion. It seemed a narrow escape after I had climbed down to the bottom by roots of bushes and clefts in the rock.

Thirsty, hungry and tired I could look up 3,000 feet that I had to climb to get back to the Poverty gulch side; it was four o'clock in the afternoon, and not a mouthful since seven A. M.

Moving along the bottoms in search of a trail I had heard of, I came across my comrades, who had just been

through a similar experience and appeared to be more used up than myself.

The trail was soon found, and nearly 1,000 feet up we came to the first water, drank the little spring dry, and waited for it to fill up again, this was repeated three or four times. Above this we came to some prospectors tents, where my friends stopped, completely tired out. I had to go on as I must start for a ride early next morning. On reaching my horse I found Fannie had cast herself, receiving a good choking, and was as badly played out as myself, and unable to carry more than my sacks of rock. This nearly broke me all up, but it would be moonlight and I was not going to lose any ground by going back for something to eat. It was a beautiful moonlight night, so clear that as we reached the crest after nine p. m. I halted to enjoy it. Far west could be seen the borders of Utah, and under the magic influences of the night, the moonlight and surroundings, it seemed then, and now as I write, as a reminiscence of dreamland. From out of this beauty on the one side, I stepped into a cloud on the other side, and could not see ten feet ahead of me. I had to feel my way for 500 feet down the trail, then we were below the cloud and could make fair progress. Before coming to Pittsburg I remembered a prospecting acquaintance, his place I found, told my story and in twenty minutes a supper was ready, although the boys were in bed and asleep after a hard day's work.

Such a meal—everything was good—as one might expect it would be—seven o'clock A. M. to after ten P. M. without a bite, after all of that climbing. An hour's rest made good for the remaining distance to Crested Butte; here I arrived at three o'clock A. M. feeling completely played out; but withal very much satisfied that I had pushed through, and now know nearly what my powers of endurance are.

With the working of these properties that I visited much better and shorter trails have been made, so that the same trials will not have to be encountered on another trip.

The next day I was off after dinner for a sixteen mile ride to Elko, over a most excellent road from Crested Butte through Elko, along the banks of the East River, which heads at the foot of Bellevue and Baldy Mountains. This river receives its start from a beauty of a little lake just on the divide from the Rock Creek slope. Here is an extremely easy pass and grade for the wagon road—it might be of great advantage to a railroad one of these days when the country beyond is sufficiently developed to warrant the building—and at six P. M. I was at Elko. Here the Central Mining and Milling Company have laid out a town, built a forty ton ore concentrator, sawmill, store and offices. It is all under the direct charge of Mr. J. H. McCoy, he also being one of the principal stockholders.

I was most pleasantly entertained by Mr. McCoy and lady for three days—snowing and raining most of the time; and only learned that I must come back to stay as soon as possible. For here was a locality that showed evidences of more mineral and fissure vein results than I had dreamed of.

The evening of September 1st found me back at Crested Butte, finishing up local notes, preparatory to seeing all that the Rock Creek country had to show.

CHAPTER XI.

Slate River—Geology of Treasury Mt. and Vicinity
—Hawk-Eye Mine—Crétaceous Rocks Here—
Rocks of the East Slope—Veins of the
Head of Slate River and Rock Creek
—Paradise Basin, Bellevue and
Baldy Mt.—Crystal Basin—
Eureka Mine--Shakespeare
Mine and Other Veins—Gov.
Kearney's Claims—
Marble.

As I rode up Slate river on September 4, 1882, returning to get a fuller knowledge of Rock Creek country, I was enabled to get a few points in the geological structure, that in the future fitting together of the rocks, I found to mean much.

Let any one interested in rock structure follow the road to Pittsburg, and in the wagon road cuts, he sees an older sedimentary rock than those occurring with the tertiary coal measures at Crested Butte. By the roadside is cretaceous shales, partly metamorphosed to a slate, containing casts of *Inoceramus*, the characteristic fossil of that age. These shale beds dip nearly 30° on the average, and can be followed along Slate river for nearly fourteen miles, to the top of Treasury mountain. Above this, for nearly half the distance is a bed of granite porphyry, of varying thickness—six to twelve feet I saw it—and above that again the tertiary coal rocks. Here was food for thought, as it is just possible that this condition of things may very much limit the coal area of the Crested Butte basin, and cut off a short distance from that town, the two lower and most valuable coal seams.

There was another strange thing I perceived had oc-

curred; as I examined the coal beds I found that they dipped slightly away from the recent lava beds, which had been erupted through them, showing its influence in raising those measures. While on the contrary the beds of the cretaceous rocks dipped toward the granite porphyry centres, that showed strongest the eruption of that rock, through the sedimentary beds of the older age. Evidently opposite results produced by similar action in different ages. It might be explained possibly by the fact, that the granite porphyry eruption was so enormous locally, that its weight gradually depressed the then plastic sedimentary rocks of the cretaceous age—just by mere weight or tonnage. Should this surmise prove to be correct it would also account for the tertiary strata filling in the depressed cretaceous basins in after ages and building up in the gorges between the mountains of granite porphyry.

Later on the recent lava eruption could only upraise, it did not overflow enough to depress.

At Pittsburg we dined with one of the owners of the Hawk-eye mine, a property that has some characteristics worth looking into, I found zinc sulphides that gave 500 ounces of silver per ton—pretty high grade zinc for Colorado—as well as some other things, that set me to looking more closely as I rode on up the river bank.

Cretaceous shales, or slates were the country rock, and it is well fissured; very many mineral veins occurring, but of low grade ores.

To one acquainted only with the mining districts of the east slope, where the fissures carrying mineral break through; for a time the formations here are more or less a puzzle. There the rocks, are either granites, porphyries, or metamorphic rocks, of an age, ante-dating possibly the carboniferous period—very hard, the fissures much narrower, hard quartz gangue, ores varying somewhat, and apparently of a wholly different method of occurrence.

Here the country rocks are soft, the fissures break through partly metamorphosed shales; this kind of country rock crumbles, drops into the fissure, mixes country rock and gangue, so that it is almost impossible at times to have a certainty of defined walls. Through such rocks fissures are more or less irregular, much wider than if they occurred through firmer surface rocks, of lower grade ores on an average, as this character of country rock adds no value to vein material; but rather for the reasons stated detracts from it. So that when the prospector gets a good mineral showing here, generally galena ores, and has high hopes of success, all at once his ore is gone, and only pieces of country rock cemented by silica, or frequently calc-spar gangue, remains as an evidence that he ever had any mineral showing at all. He cannot understand it and in many instances throws up the prospect and leaves disgusted and discouraged, cursing his luck, and the country.

Now it is not the fault of the country; I am not going to apologize for it, but will attempt to explain. These mineral fissures all lead to a harder and better country rock, viz: primitive granite, and when this section is properly worked and proved it will be found that with the change in country rock these veins will pass between smooth walls, narrower crevices, have a larger percentage of mineral in proportion to gangue, and of a much higher grade. The sulphides will change more from galena to a copper, and carry more value in gold.

The geological formation proves this, and it is a fortunate thing that this is so; I mean that there is some difficulty in getting to the real values of this section, as the rest of the State of Colorado wants some show for existence, and were the gold and silver values as readily obtained here as in many other sections, these precious metals would soon depreciate in purchasing power somewhat.

The mineralizing action in this country has been simply marvellously enormous.

There is large returns for the proper employment of capital, it costs money to reach the depths, and it will cost money to take care of the water that will be encountered in these large open fissures. All that is as nothing in these days of enterprise and abundant capital. Show the business man of means, a certain profit, proportionate to risk, and he will try; and here by the use of intelligence, money and grit, he can succeed beyond anything I dare to put in figures.

Nature has said, "Here I have done more work in storing ores, than anywhere else in the world, covered by the same surface of square miles, wrest it from me if you can and dare."

Nature does not lie, and man can and dare.

Fannie and I had company, this trip it is quite a scramble over the Slate divide to the head of Rock Creek, and at times we saw things that we wanted to examine closer, and did not always follow the trail, but went straight for what we wished to see. Looking back once after a hard scramble, the horse keeping close to me, I was somewhat surprised to see our friend coming on all fours. I did not realize before that the climb was so steep.

I had been told to come to Elko and make myself at home. I did so, and enjoyed it thoroughly; who would not? something new to see and learn every day. The head of Rock Creek with its strong mineral veins every few hundred feet, only needing development to prove their immense wealth; Paradise basin the same, Bellevue Mountain and Baldy cut through and through in every direction with ore bearing fissures, some of very high grade too.

A wagon road had just been completed to Crystal basin, three miles from here. At the head of this basin is Treasury Mountain, over 13,200 feet high, on top of it is

the Eureka properties with fourteen feet of solid ore, averaging \$45 per ton net. Galena and copper sulphides from the base of these ores. On one side of the basin is the great Shakespeare vein. I climbed to the dividing ridge from the next basin—the one General Grant named as Carl Schurz—so that I could get the Shakespeare formation in place, and broke mineralized rock across one hundred and fifty feet of surface ground.

This vein is a flat one, that is, it follows a course of cleavage between stratified rocks, having the same dip as far as can be seen or is developed. In the next basin I could see primitive granite outcropping, so that I knew all of these veins pass soon into that rock. There is almost as positive evidence of this in the gangue and character of ores of these veins, as if it was already a proved fact by development.

Across the basin from the Shakespeare is another flat vein, traceable for two and a half miles continuous, with an average of ten feet of ore solid, and all of a shipping grade. It hardly seems credible, but any one can see it, the largest continuous ore body of strong pay ore now known. Its future output is beyond computation. Across these flat veins and their enclosing sedimentary rocks, break many vertical veins, smaller in size of fissure, and in many instances, carrying a higher per centage of silver value. These probably in depth pass more quickly into the granite, and it was these vertical veins and their ores that helped to convince me, that all of the veins of this section and geological age would in depth reach the same underlying country rock, and proportionately increase in value as depth is gained in working.

I went one day to see some properties managed and partly owned by Gov. Kearney, of Kansas. There is quite a group of them in this Crystal basin on the Galena Mountain slope. In one of the vertical veins some very high

grade shipping ore is being taken out, and considerable work had been done on others of the claims, not with the the very best results, whatever the intention was, and mistakes made just from the lack of a little knowledge of the rock, it often happens, and I suppose always will.

I thought I was a good climber, but the Governor who showed me around, in spite of his gray hairs, gave me nearly enough. He is the first man I ever met, who seemed fresher than myself, after such a climb as we had that day.

In this same basin is a bed of marble, it appeared to be originally a conglomerate, composed of small rounded quartz pebbles, cemented by a lime deposit. Subsequent meta-morphism changed it to a marble; it ought to make a beautiful and unique stone when dressed. The quartz pebbles sparkling, when polished, in the lime matrix, ought to make a finish for inside work, that would give a beauty of finish surpassing many of the marbles that are now used for that purpose.

CHAPTER XII.

Elko a Cash Market for Ores—Concentrating Mill—
 First Day's Run—Such Mills Needed in all Min-
 ing Camps—Prospects Around Elko—Some
 Geology—Copper Creek—Pass to Connun-
 drum Gulch—Observations About—
 Capital Required—Dividing Ridge of Con-
 nundrum and Castle Creek—Bellevue
 Mountain its Possibilities—Lower
 Rock Creek Country—Roads
 of Gunnison County—
 Mines on Road to,
 and Upon Sheep
 Mt., Etc.

While this Rock Creek section has not been to this date ranked as an ore producer in any sense of the term, except perhaps the Eureka mines, and it might be a question, if past shipments from here have not been more as belonging to the Slate River section, than to Rock Creek—the wagon road finished into Crystal basin this fall should bring this territory to the front at once on the opening of another season.

They will have a cash market at Elko at the hands of the Central Mining and Milling Co., where this company have put in a forty-ton concentrator with the avowed purpose of making the ores of this district shipping ores, out of all produced below the grade of hand-sorted ores, and that will concentrate.

I was kept here a number of days to see this new mill start, which I was more than willing to do, from the fact that for three years past I have strenuously advocated the use of these mills in all mining camps, rather than the numberless reduction processes that almost every mining district, has idle monuments in their midst; standing advertisements of incapacity and ignominious failure.

The mill was to use a patent slimes table, which if proved a success in Colorado ores, would mark a revolution in ore saving.

The trouble heretofore has been that in the gangue to be concentrated, the greater proportion of value worth saving, existed in the form of rich sulphides, such as gray copper, ruby silver, etc., etc. These minerals are so very brittle that the crushing power used has always reduced such sulphides to slimes, and the machinery heretofore principally used failed to save and separate the slimes. Consequently the object of concentrators has been to make as little slimes as possible, with a practical result giving a wide difference from the theoretical result. That is the ores were not concentrated to as high a grade practically, as theoretical tests showed they could be.

The patentee of the slimes table, Mr. Jno. B. Wilford, had charge of the building of the mill throughout; all that was required of him was to build a mill that would run, and do its work. This he certainly accomplished to the satisfaction, not only of the owners, but of every one who has examined the mill as well as myself.

I put it thus strongly from the fact, that the patentee claimed a saving of ninety per cent. of any gray copper in the ore being treated. As this was the point where I knew other concentrating mills failed, I certainly had personal doubts, and strong ones; though I did not feel called upon to express them until the mill had a chance. When the mill started up I was present, and while there was no gray copper or ruby silver ore, to run upon, I saw those table saving an *oxide*, that settled it. I had not a word to say except praise, as there was the machinery, doing more than was claimed for it, and if they could save such an oxide as I saw them doing, they certainly could save and separate the sulphides, no matter how fine they might be crushed.

I feel that a full description of the mill would not be out of place here.

The power is water and ample for three times the mills present plant of machinery. The capacity now is forty tons per twenty-four hours. The mill is furnished with a sixty-ton Blake crusher, twenty-six inch Cornish rolls of the latest and most improved patterns, three sets of Bradford's improved ore jigs, and the slimes are saved and separated by a Wilford's slimes table, which, as asserted above, is the most successful machine of the kind I know.

The power comes from a forty-nine foot head of water through a thirteen and a half inch Leffel water-wheel with the latest and most improved attachments, such as governor, etc.

The *modus operandi* is as follows: the ore is loaded into a car from the ore bins, which have a capacity of over 900 tons; from the car to the crusher, thence to the rolls by elevator; from these to the first screen of six meshes to the inch, the ore that will not pass this screen is returned automatically to the rolls; the second screen is ten meshes for the second jig, and the third screen is twenty-four meshes to the inch.

The success of the whole machinery of course being based on the even sizing of ore particles as shown by the above grades of screens.

Each jig saves a first and second class grade of concentrates, as well as sending out the worthless gangue. Never before has there been such a perfect success in the State of Colorado, in a new mill, starting into work as this did the first day the power was applied and running and doing work as if it had always been going.

The merest tyro in knowledge of mill machinery and ores, cannot help but be impressed with the economical arrangement of all about the mill; when he sees that the ore is fed to the crusher, and all is automatic from that point

to the ore vats under the jigs and slimes tables. Even every natural advantage of the ground, upon which the building stands is made to count, and nothing forced to a point that made great cost in preparing a mill-site.

The first day's run was about six tons of very lean ore, of about eight tons raw material to one of concentrates. For one to take a handful of concentrates, then go to the natural ore and compare the two, it did not seem possible that such results could be produced, but there it was.

It is just such investments as this that all mining camps want, and not reduction works, which in ninety-nine cases out of 100 are merely idle monuments of stupid investments if no worse.

This was one of the most interesting days I have spent in this part of the country; principally because I realize personally what this kind of work means to mining men, and it is of real benefit to me individually to see what I have always advocated, proved a practical success.

The mill started on September 18, 1882, and run constantly until the ore on hand was cleaned up, and of no ore delivered to it could I find, but that a material advantage was gained, although some only went two and a half tons into one, which is very low. The idea of concentration being to arrive at a result by which the freight and treatment in cost of reduction, will be saved on the gangue or waste, and even on this lowest quantity of concentration, the saving on one and a half tons was equal to \$47.50 on each two and a half tons of raw material less the cost of concentrating.

In and around this Rock Creek country in the immediate neighborhood of Elko, I examined many prospects which certainly should have a promising future, too numerous in fact to mention individually; but which will soon be able to talk for themselves if pushed by the owners, to the

development, which the present showings certainly seem to warrant.

Hearing much from outside rumor, (this Mr. O. R. is a very irresponsible individual), of Conundrum gulch, we concluded to have a look at it.

On Sunday morning September 10th, Mr. McCoy and myself took an early start, fine bracing, clear and beautiful was the air, no where but in Colorado do we have such constant treats. It was such a morning as Theodore Winthrop—that fresh, hearty writer—described when he said he could go out and get drunk on fresh air before breakfast.

We started early, passing over the divide which separates Rock Creek from East River. This divide like the one between the Slate and Rock Creek, is principally cretaceous shales, more or less fissured; but here is a new illustration in the geology of the country. A dike of granite porphyry comes up through these shales by the roadside; and proves what I had advanced as theory on seeing the mountains of this granite porphyry in other localities. A little further down the road tertiary shales, *unchanged*, rest upon cretaceous shales, partially *metamorphosed* to slate, without the eruptive rock between as seen along Slate River.

We breakfasted at Gothic after a ten mile ride; there are many good things in this neighborhood and I regret extremely, that it was impossible to make time to give it the thorough examination which I know the district merits. The finest lumps of native silver I ever saw produced any where in the State came from the Virginia mine at Gothic.

From Gothic our route lay up Copper Creek, following the Sylvanite road as far as it kept with the stream, from there on the county was making a wagon road over into Conundrum gulch.

Our climb was up by trail, and such a trail, it might have been good with ten feet of snow to level up between boulders. How in the name—of the first prospector—material and supplies were ever packed up there, is a conundrum with me to this day. The elevation of the pass must verge on 13,000 feet above sea level. In one sheltered place was last winter's snow, four feet thick yet, through it the trail went.

The wagon road, now building, will make a good summer road without doubt, but to keep it open in winter will need rich ores to be produced and large quantities of them.

The descent into Connundrum is not nearly so bad as the ascent from Copper Creek.

We pulled up at the camp of G. A. Jackson and party, who have comfortable log cabins and appear to be satisfied that they have one of the Bonanza districts of Gunnison County. We looked at several prospects that same afternoon, and while we found strong true fissures, and geological evidences in abundance of possibility of large and rich ore bodies to be opened by development; this work and actual proof was yet lacking. There seemed to be plenty of natural evidences which said "go-ahead," and as this party with the gentleman named had made up their minds to stock up with supplies for the winter and work it through, I sincerely hope that the spring will see all that is needed proved in fact, as well as theoretically, viz: actual shipments commenced of ores that will pay.

I think that they are there, but at greater depths on an average, than the representatives of the district seem to be willing to allow.

I base my judgment upon the following observations: The claims that I saw either outcrop in primitive rocks, or through their covering of metamorphic rocks. The fissures are very strong and free, the mineral quite evenly dissipated through the gangue, no concentrated pay streaks along

either walls, nor ore chimneys giving pay ore from or near to the surface. That is what the present development shows. As a whole, I do not consider this character of formation of ore bodies a real objection, from the fact, that when depth does reach the horizons of pay ore, they will be continuous pay throughout nearly the whole length of the veins, and not divided into extremely rich ore pockets or chimneys with a corresponding amount of nearly barren ground.

Of course, it is impossible to say at what depths such ore horizons will be encountered, but that they do exist I am confident from my knowledge of rocks, and the method of occurrence of the veins here.

It will take capital to prove all this without remunerative returns for many feet down; but there is this hope to fall back upon, when the returns do come, they will be in proportion to the delay and risk encountered in developing them.

We heard much of better things lower down the valley, but it was impossible to see them this trip.

The dividing mountain range between Conundrum gulch and Castle Creek on this slope, carries such strong, rich veins as the Tam O'Shanter and Montezuma mines, now being worked from the Ashcroft or Castle Creek side.

The day of our arrival we were treated to quite a snow storm, but it had all disappeared when we started next morning at 7 A. M., to arrive in Elko in time for dinner.

I cannot be quite certain about the mineral formations at the head of Copper Creek, but it appeared that all of the mineral veins occurred in the contact rocks, between or near to the cretaceous formations and granite, while the upper part of the basin showed almost wholly granite, and apparently not fissured at all, thereby giving no opportunity for the formation of ore veins, away from the immediate neighborhood of the lines of contact.

While at Elko, I paid particular attention to Bellevue mountain, partly, I must confess, because an expert had passed his opinion on it eight years before, and stated that it was barren, not worth working upon, and it had to a great extent been left alone. I wanted to find out how my observations would agree with those of another.

This is what I found, and I do not fear to place myself on record regarding it. That there is a combination of rocks in this mountain, well and strongly fissured, which on development will give the rich ores of Washington gulch and the Irwin district.

I think that is a plain enough statement to be understood, and if I am deceived it will be the first time that rock combinations have misled me; again it may be time for some of the conceit to be taken out of me, and here is where it may be done. I can and am willing to learn yet, but constant work for ten years in practical field geology may have a tendency to make one overestimate their actual knowledge. If so, I am as anxious as any one to find out when and where I am wrong; but, in the meantime, I will stand by my statement of Bellevue mountain.

Some gentlemen from the east arriving, who were directly interested in Gunnison County by monied investments, I was invited to accompany them on a trip to the lower Rock Creek country.

We started the morning of September 16th, five of us, the State of Missouri represented by an overwhelming majority.

It had rained heavily the night before, so that the roads and trails were not in the most pleasant condition. So much did the resident member of the party resent this, that an occasional derogatory remark could be heard coming under his breath, and not at all complimentary to the weather managers; but, what could not be cured we found

could be endured, and we certainly got through all right, and I, for one, heartily enjoyed the trip.

We stopped a few minutes at Schofield, one of the frontier towns and probably the oldest in this section, where nothing ante-dates three years.

Here was as far as the wagon road went at present, although graders were at work on down Rock Creek canon, opening a wagon road through a most difficult section to the lower country.

It is the road making this summer that will help Gunnison County in the immediate future, as by the time snow comes again, every available and proved mining district will have good wagon roads connecting it with the railroad shipping points.

To capitalists seeking investment, this is a good point, as it gives the opportunity to economically market the ore produced, and places this country in that respect ahead of some of the districts where mining has been carried on for the last twenty-three years.

The first and best developed claim that we saw is the Lulu on Mineral Point slope just up from the last named town.

There was about seventy-five tons of ore on the dump, out of a crevice claimed to be twelve feet wide with pay ore streaks on each wall averaging two feet each. The ore consisted of iron, copper and zinc sulphides with a stated shipping value of \$120 to \$170 per ton. Shaft at the time of my visit about sixty feet deep.

Next along the trail came the Whopper lode, which had a ten year history, possibly the pioneer location of the district. There was 100 tons of ore on the dump out of a ten-foot crevice. The gangue was silica carrying zinc sulphides with an accompaniment of iron, galena and copper, stated to have an average value of twenty-one ounces silver per ton, evidently an ore that would pay to concentrate.

Soon after this the trail (?) led down hill into the valley of North Rock Creek, part of it was excellent, the rest, —well it was a comfort to know that there was a wagon road being opened around the other way—near the valley we switched off to see the New York mine, having quartz and calc-spar gangue, with a three-foot pay streak, the ore here was the same as the Whopper, only the zinc sulphides predominated, if there is anything to be realized by comparative looks, these zincs ought to carry well in silver, as it almost duplicated the Hawkeye mine of Slate River, but then the geological formation is different, and as that governs the ores, appearances do not count.

At the foot of the trail is the town of Snow Mass, we dined here, that is we picnicked, we had a good lunch with us, the storekeeper sold us good sardines, and the water of North Rock Creek, I am ready to affirm, is the best drink in the world.

From Snow Mass the trail winds up Meadow Mountain, branches off to Sheep Mountain, one of the well advertised districts of this section.

The first claim seen on Sheep Mountain was the Irene lode, developed by a sixty-foot shaft and thirty foot level, a perpendicular vein claimed to be opened eleven feet wide and only one wall found. It has two feet of well mineralized quartz gangue, and more or less ore disseminated through the whole material showing in the ore house and on the dump, there being about seventy-five tons of concentrating ore on hand, the mineral was the usual four sulphides, copper being the least in quantity. The iron pyrites are in some instances a mineralized curiosity as upon breaking some of the cubes, I found them enclosing particles of another sulphide, possibly molybdenite.

After the above we visited the Sifter, the Forest King, the Grand Republic, all showing more or less similarity according to development, to those already described, the

latter claim showing some manganese in addition to the sulphides named.

The Bonanza lode had a change in the gangue of the crevice, which caused me to think, comparatively, more favorably of its future possibilities, than of some of the others.

We rounded up at James' cabin, had a splendid venison supper and slept in the best built log cabin I ever saw. Very much money has been laid out here in some surface improvements on some properties; but there was an apparent hitch in the programme somewhere, and the ground has not as yet been shown up to produce, what the surface improvements would seem to warrant.

According to the almanac the next day was Sunday, (in this country that is the principal means of knowing when Sunday comes), and having a fine morning we continued our tour of investigation, visiting such claims as the Mammoth, the Cleopatra, the Gothic Belle, the Homestake the City of Detroit and the Milwaukee, this last is the only one seen producing ore that can be shipped at once, as mill returns give 293 ounces silver per ton, and tests have been run up to 1,700 ounces per ton.

A few other prospects were visited but did not show any material difference from most of those named.

Having decided to go still lower, we went over the north side of Sheep Mountain, taking a short cut until we reached a trail leading down to the valley below. From here we rode on until within sight of the lake on lower Rock Creek, just below Hat Mountain. It rained, it snowed and the sun shone. Here I could see where the tertiary rocks again came in place, and report said that below here was still larger veins of coal than those I had already seen in the Crested Butte and Ohio Creek basins.

Owing to the weather and perhaps the feeling that we had seen all that there was to be seen at present of interest,

we determined to return to Elko that afternoon; having all varieties of weather as we ascended or descended the mountains our trail led over.

Of course as usual I was loaded with rocks, and wet through, so much so that for comfort's sake I walked most of the way back leading Fannie, who was quiet enough until she began to realize the possibilities of a warm barn and oats for the night. Then what a race we had across the flats of Rock Creek below Elko in the face of a driving storm of sleet.

The highest elevation of Sheep Mountain is 10,975, it is 3,000 feet down to Rock Creek, and all sedimentary rocks. Now the granite below is what is the governing influence upon the ore bodies of all this country, so that here is possibly an exception to the rule, as the granite is too far off to count upon an increase in the actual value of the ores, beyond what now shows in the sulphides obtained at or near the surface of these veins of Sheep Mountain. They are fine strong fissures and many of them, and even if they do not show richer ores, until very great depths are reached in working, it is possible for them to increase in quantity, and so bring up the output to a profitable return for working.

I had spent all of the time in this section I could spare, and having shipped over 400 pounds of the representative rocks and ores of these districts, I returned to Crested Butte with the feeling that my season's work was accomplished, except for some special work that I had engaged to do.

CHAPTER XIII.

Crooke's Station—Tomichi Dome—Hot Springs Park
 —White Pine—North Star Mine—Tomichi Min-
 ing and Concentrating Company—Granite Porphyry Again
 —Trout Fishing and a Dinner—Cebolla Iron Mines—
 Colorado Iron and Coal Co.—Iron Product of Col-
 orado—Brush Creek—Carboniferous Rocks and
 Fossils—Mt. Teocalli—Brush Creek Mines
 —Alcyon Mine—Pearl Pass—Sulphate
 of Baryta Gangue—Tertiary Coal
 Measures—Cement Creek—Hot
 Springs—Bowman's--Head
 of Taylor River—Ital-
 ian Mt.—Crested
 Butte, Its
 Future.

My next trip was entirely away from the country I had been spending so much time in; and the afternoon of September 19th saw two of us getting off the D. & R. G. train at Crooke's station, twenty-three miles from Gunnison City.

We stopped with Mr. C— all night, this gentleman and family were amongst the early settlers of the county, and to judge from the real home comforts surrounding them, and amidst which they were living, they had come with their minds made up to stay. Although but of a few hours' duration my halt there was a delightful change from hotel and camp life.

The next morning had two inches of snow on the ground, and the atmosphere still lowering and misty. By nine o'clock A. M. we had the promise of a clear day and started.

Our route was to the south of Tomichi Dome, across one end of Hot Springs park, a delightful summer resort, and which will become one of the noted places for tourists in the near future. Up and over—by good wagon road—

a divide, on down to the Tomichi valley, arriving at White Pine in time to dine.

The principal mine I saw here was the North Star, developed 115 feet deep, cross cuts of thirty-five feet and no walls, the ore is galena with a claimed value of forty-five to seventy per cent lead, and about twenty-eight ounces of silver. Some copper stains showed in places, and an abundance of iron oxides. The gangue is lime or calc-spar, with ore and gangue standing in alternate bands.

There were a number of prospects in Galena gulch, where the North Star is, but not developed to a point where they showed any pay ore.

For supper and lodging we went on up the stream three miles to Tomichi. Here the Tomichi Mining and Concentrating company are just completing a large mill, which we went through. If an opinion may be expressed, I am afraid that the ores which we saw in the mill, will be found quite difficult to handle, and save values, by the machinery that is being placed.

The ores we saw were principally oxides, and how in the name of a suffering public, these light ores are to be concentrated by any wet process, I am very curious to find out.

There must be many opportunities for good mines here, we were shown some high grade ores, and a character of country that should yield them abundantly. Arsenical iron pyrites carrying \$4,100 in gold and silver is high grade ore.

I saw more, viz: the granite porphyry of the Slate River country, and began to feel that instead of my season's work being done, perhaps it had only commenced.

As I rode back alone to Mr. C—'s I had time to think it all over, making up my mind that as I had seen two extremes of a section of a country, I must see that between

those points if it was possible, and so fit my rock sections together from one extreme to the other.

The Tomichi was a good stream for trout, my friends put in a couple of hours fishing on the 22nd of September, before the train was due. Their success was excellent, fortunate for us that it was so, the train being seven hours late, but no telegraph station to let us know that; what a weary wait it was, and how vexatious to the sportsmen, an elegant trout stream within a few rods of the track, and the train expected every minutes for seven long hours.

Hunger brought out some resources, C— and I could clean fish and Mr. L. said he could cook them. The section house was invaded, the stock of ranch butter was secured, as well as the use of a stove and frying pan.

We had a meal fit for the gods—it was worth waiting seven hours to learn that trout could be cooked so that they melted in one's mouth, and tasted good hours after they were eaten.

In a few days a party was made up to go from Gunnison City to visit the iron ores of Cebolla, two carriage loads, a twenty-six mile drive over a first-rate road, the old Lake City stage road. The route was through the granite country, a part of which has been already described, when at Gunnison City, earlier in the season.

The Cebolla iron deposit is a peculiar formation unto itself. I was asked regarding its geology; I had to weaken; I never saw anything like it, or read of anything similar. There is iron enough, over a mile square of it, apparently overlaid by trachyte at one time. The country rock is granite. The ore is heavy, black magnetite, of fair grade of iron, but carrying, as I was afterwards informed by one of the representatives of the Colorado Coal and Iron Company, too much titanium to be practically available in iron manufacture.

That appears to be the great drawback of Colorado

iron ores, but there are such enormous bodies of iron in such various methods of occurrence throughout the Centennial State, that I for one hope in time to see Colorado furnishing more of that metal than either of the states of Pennsylvania or Missouri.

The Colorado Coal and Iron Company have proved this for Colorado ores, that when they can be utilized they beat the world.

Railroad men say the Bessemer steel rails turned out of the works at Pueblo, are better than those made anywhere else in the United States. Foundry men say that their pig iron makes castings as near wrought iron for toughness as it is possible for castings to be; and builders show the nails of the C. C. & I. Co., and claim they are as good as the hot-pressed nails of the east. In four months from the starting of the nail works at Pueblo dealers could not sell an Eastern nail in the State.

After the foregoing trip I spent a couple of days again going over the coal measures of Ohio Creek and Crested Butte basins, in company with a gentleman from Pittsburg, Penn., one of the large coke manufacturers there.

A few days afterwards my friends started east, evidently well pleased with what they had seen and learned; leaving me to do what I was aching to accomplish, viz: examination of the country through, from Copper Creek to the head of the Tomichi.

It seemed a big undertaking to do right, before snow came, but I had this to help me out, past experience in this country, had given me many points, and I could work more rapidly than I had been doing.

The first trip was from Crested Butte up Brush Creek, starting on the 29th of September. I had the use of a fine, powerful horse, broken to trail and mountain climbing for two years before, one of these knowing horses who would not stand tied, but drop the bridle on his neck loose, and

and he was always to be found where you left him. He would gallop with sacks of rocks on the saddle, and seemed to know that I did not want them to rub, as he hardly shook them; and, before "Nig" and I parted, he had got so far along in my business, that, as far as he could see a freshly broken pile of rocks, he made for them, stopped for me to get off and examine the pile; and, if I did not, he turned his head to me, an apparent look of inquiry would be in his eyes, as much as to ask, "Well! what is the matter with that lot?"

The route was over the new wagon road, made up Brush Creek.

Shortly after leaving East River on this road, one soon observes a remarkable change in the geological formations, and for some reason which I could not determine at the time, much lower rocks in the geological horizon appear. I found one strata of limestone with carboniferous fossils, and near by was another rock which had every appearance of being useful some time in the future for the manufacture of hydraulic cement. These were the oldest sedimentary rocks that I was certain I identified in the whole of the Gunnison country.

As the road ascends in its course, the student finds himself climbing through a geological series, as it were. The first of the cretaceous is a red sand stone conglomerate, and which is possibly at this locality the equivalent of the Dakota red sand stone, or number one of the eastern slope series of the cretaceous rocks; afterwards a few of the older metamorphic rocks are found, and finally you ride out amongst the primitive. Of course a series of upheavals and erosions have apparently reversed the formations. In connection with the oldest rocks, I found a beautiful fine grained syenite.

From several places on the road I had an excellent view of Mt. Teocalli, and regretted much that it was not

directly on my route, as from where I saw it, the structure appeared to be strata of undisturbed sedimentary rocks, which past convulsions of nature, had, from a possible local cause, left alone. But the breaking of strata all around, with the aid of subsequent erosion, had left this fragment of vast horizontal beds of sedimentary rocks in the form of an elevated mountain. Apparently there all of the strata were from the latest, except the tertiary, on down through the series for thousands of feet.

This Mt. Teocalli may stand relatively to the rock history of this country, as the stone discovered in Egypt did to the unknown symbols of a very ancient people and a more modern language, and which enabled the student to unravel the history of ancient and unknown races of mankind.

So may you Mt. Teocalli, carved by nature be the key to all of the foregoing history of your small part of earth structure; I would have liked to have made your personal acquaintance anyhow, but I had to do without that this time.

Clear across the country to the great Uncompahgre range one can have an almost unobstructed view, and amongst the highest of its peaks, there is apparently the duplicate of Mt. Teocalli; what you both have to say I will know sometime, I promise myself that much.

The mineral section commences again at the head of Brush Creek, veins outcropping in cretaceous rocks, flat ones following the dip of the strata.

Here I found Capt. McCarty and party, and accepted the miners hearty invitation to stay all night and make myself at home. The latch string always hangs out among these men; and nowhere on earth does one feel he is more heartily welcome, than among the mining men of Colorado, it is in the air they breathe.

The next forenoon I used in visiting the Alcyon claim, elevation nearly 13,000 feet, and which, while it had not

much development, showed a strong crevice, in one place ten feet of croppings. Very high assays are claimed for this property, the extremes being thirty-five ounces to 14,000 ounces silver per ton. I also saw the Kansas City claim, this occasionally yields small lumps of horn silver in the surface workings. There were other holes to be seen, but I wanted to see the formation to the top of Pearl Pass. After dinner I started up the road, recently finished as an outlet from the Castle Creek, and Ashcroft sections; as I neared the top the appearance of the possibility of a mineral district became much stronger, and although the elevation is so great, the road being nearly 13,000 feet above sea level. I saw some evidences that promise good things, and believe work will find them.

From the Pass late in the afternoon I could look over a vast extent of new and to me unknown country, but of which I had heard much, and which I must leave until another season's work.

However the causes for veins and ore bodies, on the Ashcroft side of Pearl Pass divide, were in their day and generation very much more actively at work than on the Brush Creek side. This I know from the visible results; being belated I rode on down to Ashcroft to stop all night, then obtaining an early start next morning, I took time to ride around somewhat, and found more and larger outcrops of certain kinds of ores than I was accustomed to seeing.

Some of the veins showed sulphate of baryta (heavy spar) in the croppings. While it is not proved what this may indicate in this part of Colorado, this spar frequently occurs with rich silver ores in Custer, Park, Clear Creek, Gilpin and Boulder Counties. In Clear Creek County the miners from experience call it "mother of silver," and will go down on it, even if it does not show in starting an ounce of silver per ton; and have invariably run into rich silver ores in paying quantities.

Now the foregoing must not be taken as a general rule applicable in all cases, by any means, as it might be entirely different in this Pearl Pass country. I advance the statement that the workers of these claims may have an additional knowledge for practical observation in their individual locality.

Sunday evening found me back to my quarters in the Elk Mountain house.

A short trip was made to satisfy myself regarding the practical result of a theory, I had advanced in connection with the Tertiary coal-measures, and finding the proofs of my theory I felt satisfied, it will be noted elsewhere, when I come to sum up the geology and practical values of these coal-measures.

Eight miles down the valley from Crested Butte Cement Creek empties into East River.

One fine morning in October found "Nig" and I out on an exploring expedition up this creek. I could not learn much about it previous to a personal visit, although in an earlier day I was told that a trail went through here on across Taylor Park and over the range to Leadville; but since the building of railroads into Gunnison County, this route had fallen into disuse, and as near as I could learn from those whom I questioned, it is at present more or less of a *terra incognita*.

Half a mile up the creek, out of the East River valley, there is a large spring from which a foot of tepid water is constantly flowing, the largest spring I saw in the county. It is heavily charged with carbonate of lime, and has made a thick deposit of travertine along the bank of the creek. This spring is quite a place of resort in the summer season by the Crested Butters for bathing, and might be made an enjoyable summer resort, perhaps will be in time.

This travertine has been utilized to some extent by burning into lime, but of what quality I do not know.

Appearances are certainly against the commercial product, as the kilns and surroundings are now wholly deserted and idle.

About three miles up, the creek comes through a narrow gorge with nearly 300 feet of fall, an opportunity for considerable water-power when the day comes for its use.

The trail turns to the left and winds up another and more accessible gulch, crosses a small open park, then down to the most lovely valley of Cement Creek.

From here for twelve miles the ascent is quite gradual on the south side of the stream, the north side where the trail goes being broken by abrupt, outstanding ledges of the cretaceous rocks; notably the red sandstone conglomerate seen up Brush Creek. About two miles from the head of the stream, is a very strong spring of sulphur water in the bed of the creek.

Up here on the south bank is Italian Mountain, one of the landmarks of the United States geological survey under Prof. Hayden. Seeing that the dividing ridge at the head of Cement Creek was low, I rode on up to its crest. There are abundant evidences of minerals here, but no work of any account done, some prospectors had commenced, as I found their stakes with a date not sixty days before my visit, but they had all left for the winter.

Seeing some cabins and evidences of work in the other valley from the one I had traversed, my horse and I slowly wended our way down a trail to them. We found evidences of recent occupation, but the inhabitants were not there, and I had to conclude that with the birds they had migrated until spring.

I was in somewhat of a quandary, as I did not feel certain of the correctness of my geographical position. It was palpably evident that I was there, but where was I, and how far was it to the nearest supper and lodging? It was a conundrum that I had to give up, but soon found

"Nig," thought he could solve it, so giving him his head, off he started down stream of an unknown country.

The trail was marshy, it was getting very dark, and at times I could feel my horse under me making mighty efforts to keep from being mired.

A couple of hours brought us within sight of lights, and a little after seven p. m. I was dismounting at the toll-gate, on the road between Ashcroft and Buena Vista, in Taylor Park, locality Bowman's. Here was accommodation for man and beast, and we were glad to find it. A good supper a large open hearth fire to sit by and I was soon recovering from the effects of a really hard day's work. I learned we had come down one of the branches of Taylor River for six miles, and my geography was soon cleared up.

At seven A. M. of October 4, 1882, we were on the road returning over the route of the night before. I was bound to climb Italian Mountain if it were a possible thing; it proved to be quite a climb too, up a steep slope of uptilted cretaceous rocks, more or less fissured, and showing some evidences of mineral, but not enough to pay as yet has been opened; a few holes had been scratched in various places, but not a soul appeared to be around, whom I could question, some recently dated stakes showed that prospectors had been there within sixty days, trying their luck, they were all gone however at the time of my visit.

The view from the top of Italian Mountain is bounded by mountain ranges in every direction, but what thousands of square miles lie within this boundary. One could overlook the whole of Taylor Park, all of the valleys of the streams centering at Gunnison City, and beyond to the boundaries of the San Juan and Uncompahgre Countries; sweeping round to the eastern borders of Utah, thence onward connected by ranges and mountain peaks to the grand old Continental Divide nearest to me.

I could not help but think that if the whole of this circumscribed area was proportionately as rich in natural products as the small part I had so carefully seen, why here in time could be produced wealth equal to the present known wealth of the whole world; and withal it is a country beautiful to live in, and progressive enough to have a feeling of pride ringing in the words of the man who will say "here I live."

I was pretty well loaded with specimens when I came down the slope. I had learned a trick on the North Fork of Anthracite Creek, so selecting a wide rift filled with small stones, etc., I went down in less than fifteen minutes a mountain that had taken three hours to climb.

"Nig" had not been idle while I was absent, for getting one of my sacks opened he had made away with ten pounds of oats and looked more than contented with himself. He carried the outfit into the Buttes in time for supper.

Having thus finished all of the territory that was most convenient to Crested Butte as headquarters, I packed up and shipped to Denver a large amount of ore illustrations of the country which I had seen so far, and made ready to move on to Jack's Cabin.

Before leaving Crested Butte it ought not to be out of place to say something regarding its future, which principally lies in its possibility of making a second Connells-ville. Here it is that such excellent coking coals are known, and through the Colorado Coal and Iron Company are being utilized. Heretofore cokes has been manufactured from the slack, or fine product of the mines, by being burned in open pits, a wasteful method. Having proved in this way the possibilities of the property, this company is now building fifty coke ovens which ought to be in full operation by the spring of 1883, if not before. The railroad is being continued up the Slate River to the Smith coal-

banks, where it is contemplated laying out extensive plants of breakers, etc., for active and large mine working during another season.

These operations will give employment to large numbers of men, and be the pioneers perhaps of other and larger industries in the near future. It already appears to be object enough for the South Park Railroad to find a way to get there, and share the freight of the natural output of this basin.

The town is situated in a lovely part of the Slate River valley, and plenty of interesting places for sight-seeing near by, as well as many things yet to be secured and developed by the capitalist.

Withal it is blessed with a good and well managed hotel, the Elk Mountain House.

CHAPTER XIV.

Good-Bye to Crested Butte—The Doctor Mine—The
Northern Lava Mesa—From Howville into
Gunnison City--Geological Changes--Ohio
City—Mistakes of Mining Men in
Regard to Smelters—Moving
Onward to Pitkin.

On the afternoon of October 6, 1882, I bade good-bye to Crested Butte for the season, and rode on down to Jack's Cabin. At the foot of, and to the north of Round Mountain, Cement Creek joins East River; here I saw a dump and leaving "Nig," I climbed up to examine it. I found a foot of iron stained material in a forty-foot tunnel, evidently of no commercial value.

As I returned to my horse he had taken a notion that it would be a fine thing to roll with all my traps on his back. I began to scold, when I got within ten feet of him he deliberately trotted off. That horse made me wade Cement Creek once and East River three times, before I headed him off at Wallace's Camp near the foot of Crested Butte Mountain. He knew he had done wrong, and carried me to Jack's Cabin in little over an hour; then without supper he had leisure to study upon the error of his ways, with a probable conclusion not to do so any more; as that was the first and last trick "Nig" ever played on me.

The East River valley widens considerably south of Round Mountain, and here are the houses of Howville, or Jack's Cabin, occupied at the time of my visit by Ben Sherwood, one of the pioneers of Gunnison County. At his house I was entertained for five days, occupying the time in examining the surrounding country. The principal place of interest that I saw was the head of Spring

Creek and the "Doctor" mine. At this time to get there we crossed the low divide between East and Taylor Rivers, passing a profitable potato ranch in the Taylor River valley, then on up stream past the mouth of Spring Creek, hence by trail up a side gulch to its head, then over a divide to the "Doctor" mine or head of Spring Creek.

On this property I found a tunnel run in 150 feet on ore lying nearly flat, and development of over thirty-five feet in width each side. The ore body ranges four to ten feet thick, and is much liked by smelters on account of easy treatment and high per cent. of lead. This ore is spoken of as carbonates; but the most of it is rather a sulphate than a carbonate, as I found a great deal of anglesite, (sulphate of lead) among it. The gross value is about \$44 per ton, \$10 net is paid by the Hillerton smelter for this ore on the dump, the owners of which pack it by burros to Taylor River road and from there haul by wagons through Union Park to the smelter, where it is used as the lead, or bullion base for the reduction of the higher grade ores of Tin Cup. This mine at the time of my visit had about \$160,000 gross in sight with the small amount of development named; the ore is very easily and cheaply worked. The ore-body has a slight dip east, with the hill-side, and as it is followed in that direction I think it will turn downwards much more rapidly, and with depth change from the present form of ore composition to galena, with possibly a higher value in silver.

Next to the "Doctor" claim is the King lode, from which in an open cut not over twelve feet deep. I saw masses of galena taken out as large as could be lifted into a wheel-barrow.

The country rocks are cretaceous and with the granite will make contact walls for ore bodies.

Up Spring Creek itself, a large force of men were at work opening a county road to its head. Through here

an easy grade down hill will be opened from this mining district, connecting within eighteen miles, with the D. & R. G. Railroad at Taylor station, thus making the outlet and possible cash market for this district at Gunnison City.

There does not seem to have been as yet the amount of prospecting in this Spring Creek district that the present showing and rock formations seems to warrant; but that will rapidly follow, as soon as transportation (another season) is opened, and there is a strong probability of many more ore bodies being found as good as those already named.

I spent one day climbing and examining the northern lava mesa on the divide between Ohio Creek and East River, to find that the two mesas were originally one, and that subsequent erosion had cut them in two. The lava was about fifty feet thick, flat, table like on the top, covered with a growth of pines, not much deadwood or fallen timber, a little over a mile square, and from each edge a magnificent view of the surrounding country.

I started up an elk family while I was there, consisting of a buck, doe and fawn, also saw plenty of wood-grouse.

The lava flowed over, and is subsequent to the tertiary formation. It was this volcanic eruption that fissured the tertiary rocks, so that the ruby silver veins of Irwin could occur, and makes them the most recent of any in geological age.

I came down on the west slope of the mesa examining the tertiary rocks exposed, and on through the eroded basin to East River. I hoped to find evidences of coal seams, and that the heat and pressure of the overlying eruptive rock would have changed such coals to an anthracite. I did not find any coal float whatever, only masses of lava which show continuously from the mesa everywhere down the slope, the same as on the Ohio Creek side.

While at this place I climbed Round Mountain, find-

ing it a combination of uptilted sedimentary rocks, with trachyte, eruptive granite and granite-porphry, representing perhaps three different ages of eruptive rocks in the one mountain.

This locality is referred to again in the summing up of the season's work, so that it is sufficient to say now that I was somewhat disappointed in what I expected to find; those expectations were wholly based upon the representations of others, and that evidently without sufficient knowledge of what they were attempting to describe.

From Howville I meant to ride up into Union Park, where extensive gold placers are worked each year. I had been quite curious to get into this park all of the summer, that I might learn, if possible, the source of and the method of occurrence of this placer gold. The day I had set upon for going snowed, and I was most forcibly reminded that Gunnison was a very large county, and I had places to go yet that I must have bare ground for examinations, and that what I could not see well now I had better leave for another year.

So on the morning of October 11th instead of Union Park, saw "Nig" and I headed for Gunnison City in a snow-storm that had been threatening to catch us for the last two days.

We followed the toll-road down the East River to its junction with Taylor River, at this place is where Gunnison River commences.

We appeared also to be descending the geological scale, as soon no more tertiary rocks were to be seen, then passed out from us the cretaceous, the last of the sedimentary rocks being a sandstone and which I would place amongst those of a carboniferous age, this was broken through in places by red eruptive, feldspathic granite.

Then we finally rode out into the flat gravel deposit upon which Gunnison City is built.

A rest here of one day to recuperate, which meant in my case catch up on correspondence, purchase a few necessities of clothing, etc., and then I was off for what is locally known as the gold belt near to Ohio City about twenty miles from the City of Gunnison.

A ride of twelve miles up the Tomichi River to Parlin's in time for dinner, here Quartz Creek joins the Tomichi. This twelve miles is over an excellent road, with the hay ranches along the stream bottoms, the roadside bordered with a strange character of conglomerate, eroded in some instances into fantastical shapes. Upon examination of this conglomerate it appears that the cementing material is volcanic ash. In a former chapter I have mentioned beds of volcanic ash found near to Gunnison City.

It would seem as if at one time in past ages that the present site of Gunnison City was the bed of an inland lake or sea, into which the drainage of the surrounding country centered, and not so very many ages ago either. Near this body, perhaps to the eastward of it, there was an active volcano, which in its period of life gave out large quantities of ashes. These falling into the lake, were mingled with boulders and pebbles brought down by the stream, thus making the present accumulation.

I must confess that the above is only a partial theory, as to work the basin out in detail, and be able to make proper deductions from facts found, one must carefully examine the outlet (Dark Canon) through which this body of water was drained, find out if it was the result of long and continuous erosion or the result of a volcanic eruption producing a fissure, afterwards enlarged by erosion. The point or locality at which the ejection of ashes occurred must also be found, the fact determined whether it was of the same age as the lava flows found near Jack's Cabin, or later in geological history. I do not

think from the present condition of the material it could have been earlier.

To read this basin aright one must determine whether there was a lava flow first from a crater, followed by ashes without an intermittent period, or determine whether there was only one outbreak to produce the seen results, and that continuous until the volcanic force was spent. It would, on the small examination that I could give this section, appear to be one continuous pouring forth of hot ashes, this deduction is made from the present appearing result of a homogeneous mass of ashes on what might have been the shore line of the body of water and a similar result in the water, as the whole mass of conglomerate shows the same cementing material.

I have not time to prove all of that now, and make a note of it, to jog my memory in the future, of something still to do in this part of the country.

It is eight miles from Parlin's to Ohio City, up the Quartz Creek valley. Through here the Denver & South Park Railroad has found a way to the City of Gunnison, and is now bidding for its share of business with the Denver & Rio Grande company. If I have read the country's "title clear," there is, in the near future, business enough for both.

As one enters what is a new geological field a sharp lookout is kept for changes in the formations. Here we start with a showing of carboniferous sandstones, these give way as we ascend Quartz Creek, then the red granite shows in small patches, as well as occasional spots of the older metamorphic rocks, mica, shists, etc., but about five miles up the stream from Parlin's, all changes to primitive granite. In this last noted change, one sees the possible approach to a mineral section, by the frequent appearance of strong veins of white quartz in the granite. A turn in the road soon brings us within sight of the railroad station

and collected houses and cabins designated as Ohio City.

I found a hotel kept here by a genuine Michigan tenderfoot, slightly adulterated with a year of residence in Kansas, simple and honest, but withal rather inclined to imagine that the investment in mining properties did not require so very much judgment as it would require to buy a mule. This gentleman died of pneumonia shortly after I had left his house, I am sorry to say.

The mining section about Ohio City is but three years old, the same as all of the rest of the country I had seen so far. The lesser Ohio Creek joins Quartz Creek here, and is some nine miles to its head, cutting through primitive granite, birds-eye porphyry and the older metamorphic rocks, such as mica and garnet schists, gneiss, etc.

Through these rocks break very many gold bearing veins, showing free gold ores from the surface to a small depth, then changing to arsenical iron pyrites carrying gold.

This section is a duplicate of Gilpin County, Colorado, on a smaller scale.

The usual mistake has been made here to start with, that appears to be a necessity of all mining camps, new as well as old; mills were put up before the properties were sufficiently developed, to prove what the permanent ores were to be. These mills were for saving free gold by amalgamation, but as soon as any depth was gained, or development reached a point where the ores changed from oxides to sulphides, the mills would not, and could not, save the value. Consequence as usual the district condemned, where it is not the fault of the mines, but of the men controlling them. If mining men will only learn that it is necessary to fully prove their properties before building mills, very much of these loses will be saved; but it almost makes me despair when I go into mining camp after mining camp,

and see that they all go through the same courses of loss without variation.

A mining man has no right to believe that any process will treat his ores until it is proved, and it cannot be proved until his mine is developed.

There are now, and more will be found, very many good prospects in this district, but the kind of mills needed are stamp mills, with improved concentrating machinery to get the sulphides in the ores into a condition that will pay to ship to smelters. That is the only kind of mill that it is safe for a mine owner or mining camp to touch at all; as where hand sorted shipping ore can be produced, there is always a much larger quantity that can be made available by concentration; and the recent improvements in concentrating machinery are such as to make \$10 rock pay ore if it exists in quantity enough, and there is sufficient gangue or waste to be got rid of, to let seven tons of natural product make one ton of concentrates.

I keep urging the above so strongly, and always at every opportunity, because I am personally interested. That is, the success of my business is based upon successful mining in Colorado, and I know what it means to see camps using proper concentrating machinery, rather than sinking money in any contrivances, which are only good on paper, and not much use there.

Past the head of Ohio Creek the contact formation also goes through towards the direction of Pitkin, which now has the reputation of being the liveliest camp in Gunnison County.

Considerable prospecting has been done along this contact, but no pay found as yet.

At the head of the North Fork of Ohio Creek is a very peculiar schist, and an immense dike of birdseye porphyry crossing in the direction of Chicago Park near Pitkin. At the time of my visit the Midnight claim was

down with a shaft 175 feet, and other similar claims were opened more or less, most of them much less, among which might be named the Dollar Store lode, Dodson Extension, Idaho Girl, Lead Chief, Goldsmith, and very many others, which are as yet mere prospects, but all mines must be prospects first.

Some very high grade gold ores have been found in this neighborhood, as well as some showings of copper pyrites and galena.

On the whole I am favorably inclined to the vicinity of Ohio City, and think that development will prove very much more in value than now shows, but work must be done to prove this, and a claim is only worth what it shows itself, without any reference to what occurs near by.

I spent five days riding around this section, and having given it all of the time I dared to, not as much as I would like, I moved onwards to Pitkin.

CHAPTER XV.

A Prettily Situated Town—The “Silent Friend”—
Some Very Promising Properties—A Superior
Railroad Outlet—The “Porcupine” Group
—The Mineral Farm, a Geological
Puzzle—The Silver Islet
and Fairview
Mines.

The town of Pitkin is prettily situated on Quartz Creek, about seven miles above Ohio City; an easy wagon grade existed and the South Park Railroad finds no trouble in building from here to Gunnison.

Pitkin must have between two and three thousand inhabitants, and during the year 1882, attracted more attention than any other camp in Gunnison County.

The rock formation for most of the way from my last stopping place was metamorphic, which changes to granite and cretaceous rocks just before one rides into the open flat upon which the town is built. These rocks are in what is the mineral belt of Pitkin, and in many instances give the opportunity for contact veins, very large, strong and well mineralized. Of these at present the finest and best developed is the Silent Friend mine, about four miles from Pitkin. This mine at the time of my visit had acquired a wide-spread reputation for the size and value of its developed ore body. The shaft was seventy-five feet deep, with five feet of solid argentiferous galena in the bottom. In the ore house was 150 tons of the same, that I estimated had not 500 pounds of waste in the whole lot. The value claimed was about \$80 per ton in silver and lead. Occasionally very nice specimens of grey copper are found that will assay into the hundreds of dollars in a silver

value. At this time they were placing a hoisting engine on the mine, and would soon be in shape to work double the force of men and treble the output.

The South Park Railroad comes up this North Fork of Quartz Creek, making a "U" as it climbs out of the valley, here a shipping station has been put in, and makes a great convenience to the present and future mines of North Fork.

I did much riding about here and visited some very promising properties, showing large bodies of ore in proportion to development. Among which might be mentioned the Silver Islet and Fairview, and later the "Way Up" mine, is acquiring a good deal of prominence.

Having to visit Pitkin in February, 1883, I found nearly 100 men employed here in mid-winter with three to four feet of snow on the ground. It is a God-send to Colorado to be able to find out that work here can be carried on all winter; instead of miners and mine owners spending this season in Denver and other cities they have found out in the winter of 1882-'83 that their time can be more profitably employed at home.

A good wagon road leads from Pitkin to the head of Ohio Creek, the gold belt, and makes as good an outlet here as down to Ohio City. Another road has been made up the North Fork of Quartz Creek crossing the divide of Taylor Park and giving Tin Cup a better railroad outlet than she was blessed with before.

On this divide and near to Mt. Sigel, is the Porcupine group of mines, embracing 4,500 feet on one vein, and which shows a continuous outcrop of mineral for the whole distance named. This company has a fine property and appears to be doing this work right. On the principal vein a cross-cut of seventeen feet was run towards the hanging wall, but not to it, all mineral. The owners claim an average of \$50 per ton in gold, silver and copper; of

which one-half ought to be free milling ore and can be mined, milled and reduced to bullion at a cost of \$5 per ton, with the sulphides concentrated and shipped as a smelting ore. Judging from the size of this vein, its character of ores in connection with the country rocks in which it occurs, this ore ought not to change much in composition for nearly 200 feet in depth. It evidently can be made a very large producing property in the near future.

Chicago Park, two miles from Pitkin, has numerous prospect holes through it; they appear to have been sunk down to a coal seam of the cretaceous age and then abandoned. This is the first coal of this age which I had seen on this slope, although from the immense mineralising action of this neighborhood the coal was entirely worthless, being strongly impregnated with iron and sulphur. I was pleased to know of its occurrence, as it helped me very materially to identify geological horizons.

While I cannot mention all of the prospects and indications which I saw in this neighborhood, I was particularly struck with the properties known as the Mineral Farm.

It was claimed that this had been a geological puzzle to all who had seen it; perhaps it was, and I may be overconfident regarding my own judgment of undeveloped properties; but I said then, and feel now, that it is one of the bonanzas of the Pitkin district.

The trouble appeared to be that there was so much rich float, that they did not know where to look for the ore body in place. It appeared to me to be a simple matter to demonstrate, and I am sure it can be found and at no extraordinary expense either. They find float and plenty of it carrying 50 to 700 ounces of silver, and quite frequently native silver occurs.

I had a pleasant stop of several days at Pitkin, made many acquaintances I would like to meet again, and saw some things and heard of more, that I will not rest con-

tented until the time comes for me to know more of them; which I hope may be the coming year.

The Denver & South Park Railroad is doing for this section what the Denver & Rio Grande is accomplishing for the mining districts which it passes through. There is one trouble with both of them, apparently, which I do not understand, and I may be wrongly informed too, and that is the attempt to force products the whole length of their line to Denver and Pueblo. These two roads both meet at Gunnison City, which is the natural and commercial centre of all this country I have been traveling over. Now it seems to me that if these two roads would combine to give Gunnison what naturally belongs to her, they would, from increased population, requiring the bringing in of enormous supplies for their subsistence, as well as the out-freight of bullion and manufactured products, have in a very short time much larger freight earnings, than it will be possible to get on mere transportation of the ore product over the Continental Divide.

But railroad men are business men, and more frequently farther seeing than those whose experience is locally circumscribed, and to the managers of these roads there may be good and sufficient reasons for discriminating against a large commercial city at the point named, all I can record is what seems good to me.

We had a couple of spurts of snow but the warm sun had cut it off within twenty-four hours after falling, with the exception of spots on the north side of the mountains, the country was still bare enough for me to continue my work.

Following the old stage road some nine miles up the Middle Fork of Quartz Creek. I think it is (where the south branch is I did not see) one comes to Woodstock, the first station on the South Park Railroad west of Alpine tunnel. The country rock this distance is almost wholly prim-

itive granite, and not much evidences of mineral that I could discern riding along the road, until one comes nearly in sight of the water tank, below here is the Silver Bell with ninety feet of development, which the owners represent as giving \$15 per ton silver with a trace of gold on the surface; while the cross-cut below gives iron pyrites running from \$200 to \$400 per ton in gold. This is an evidence of what will be found, from here on over the divide to the headwaters of the Tomichi, from the fact that hereabouts I saw many strong and promising veins, some apparently developed properties; but of what kind of ores, of what quantity and quality, I could not tarry to learn, as I was more than anxious to reach Tomichi that night, and I had five miles to make from Woodstock to that town.

Before passing entirely away from Pitkin, I should say that the Silver Islet people are building a mill for the treatment of their own ores, putting up machinery and furnaces to carry out the Carter-Bancroft idea of amalgamation. I fear it will be another failure, as the principal is not right for silver ores to save their full value. The mill was not completed while I was there on my first visit, so that I could not judge entirely of its possibilities, and what might seem to be good in theory, viz: the roasting furnaces might fail in practical use.

I have said so much already about chlorodizing and amalgamating silver ores, in referring to the Pioneer mill at Irwin that it might almost seem a worn out part of the story. But as near as I can learn, this Carter-Bancroft process is the old Lightning amalgamation process under a new title. Under the old cognomen it cost New York parties, on property near Lake City, \$80,000 without any adequate returns; under the last name it has reappeared at Empire in Clear Creek County, to treat low grade gold ores, and the only real work there that has been published and attested to was over the signatures of Prof. J. Alden

Smith and Mr. E. E. Burlingame, of Denver, who watched the treating of about ten tons at a cost of about \$4.50 per ton, on ore that was only worth \$3.50 per ton before it was treated; I never could figure out anything so very practical and good in that. Finally it turns up at Pitkin as a chlorodizing mill for silver ores, if this practically fails, as I fear it will, I do hope enough will have been paid on this process for experience by mining men in this State. On the other side I must be just, and add that the gentleman in charge of this property and mill, assures me that he has thoroughly tested the process and that it is most certainly a triumphant success. Should it prove to be so, no one will more cordially welcome and make known such facts than myself, as it will be the first silver amalgamating mill to be a success in the State of Colorado; and I should be only too glad to do my part in making a success that means so much to all mining districts, known everywhere.

A new wagon road was opened this fall from Woodstock to Tomichi; after one crosses the divide by this road, the evidences of strong veins with possible ore-bodies, become more and more apparent. What they really were, or appeared to be to me as I examined them more closely, I will leave for another chapter.

CHAPTER XVI.

First Knowledge of Tomichi—Fissure Veins of Gold
and Silver—Causes Against Its Development—
On the Edge of the World—Convinced of
Negligent Prospecting—A Recall—
Between Two Fires—A Ten
Mile Walk, then Salida—
The End of a Narra-
tion of an End-
less Work.

Tomichi was first known to the outside world a little over three years ago; then Tomichi and White Pine stood prominent as two of the new camps, of which great things were expected at once, but of which great things did not come. Not from any fault of the country I now find, but rather from the fault of the men occupying this section. They have a country with naturally boundless wealth, but having the great drawback of individual inertness pertaining to the inhabitants. The reason Tomichi did not come up to first expectations at once is to be found in the now realized fact, that *work* was not and is not being done on the scale and basis which the section really warrants.

For five miles down the stream on the north side, the granite is laid bare, and fissured on an average nearly every 500 feet, with good gold and silver veins, containing those metals in a native state sometimes, veins two to seven feet wide with very high grades of ore. The iron pyrites here, like those of almost all rich sections are high grade, I saw a picked specimen of arsenical iron that would assay \$4,100 of gold and silver per ton, from a dump I obtained a number of specimens of wire silver, and still these mines are not worked, or were not at the time of my visit.

Among the claims that might be named which I

visited personally, and all of which showed sufficient encouragement for more and greater development, are the Lilly, Rights of Man, Alwilda, Twin Lakes lode, Little Laura, Hiawatha, Tucker, Gypsy, Grand View, Niagara, Lewiston, Sleeping Pet, Lehigh and Carrie tunnel.

These are all in the granite and were they anywhere else than at Tomichi, they would be worked. The owners claim that they have not means to develop them, but should one want to buy he is asked ten prices for them. This must be changed, to make the camp a success, my advice is sell part of your holding for what you can get in cash, take that money and develop the rest to something that will sell at the larger prices; the day has gone by when \$10,000 will be paid for ten and twenty foot holes; and just as long as you do not see, that there is no end of new mining property added to the market each year, just that amount of time is lost irrevocably to you men of Tomichi, and in time, a very short time too, you will freeze yourselves out. Buyers will not pay thousands for what they can get elsewhere for hundreds that is just as good.

At the head of the stream is Monumental Mountain, composed of the same granite-porphry that I found so much of at the other end of the country. This mountain makes part of the great Continental Divide, rearing a crest heavenwards, until an altitude of nearly 14,000 feet is reached above sea level. Below this, and running nearly parallel with the Tomichi River, commences the great contact belt, now opened more or less to Galena gulch at White Pine, a distance of nearly four miles.

This belt ought to yield vast quantities of mineral, of medium and low grade ores. There is opened on it the New York Claim, Pocahontas, Red Cloud, and Legal Tender on Clover Mountain, which is nearly as high as Monumental Mountain; of this "Nig," and I went to the top, one might almost imagine themselves looking over the

edge of the world. Thousands of feet below us was the valley of the Arkansas, stretching out for miles a clear and uninterrupted view far down the stream to Salida. In another direction we could look far across country to the valley of the Gunnison; if we were not looking over edges of the world, we did stand upon the very back-bone of the American Continent.

Although not a Columbus by any means, in a small degree I realized that I too, might at such times and places, have all the feelings of the moment, when the great discoverer first set eyes upon the New World.

Below Clover Mountain, and opposite to the town of Tomichi, an entirely different formation sets in, which if it does contain ore bodies will be found to have very different mineral compositions from the contact veins. After this again comes the cretaceous rocks and granites to Galena gulch and beyond.

The most promising mines are the North Star, mentioned in a former chapter, the Parole, Iron Duke, and Carbonate King. This last was opened after my first visit, galena was found at grass-roots, giving in car load lots, thirty-five ounces silver, and fifty-five per cent lead. The first six feet gave a car load of ore, ditto the next three feet, and so on, large masses of galena, no walls, and hole about twelve feet deep when I saw it. Since then, or at the present writing, it is reported that two car loads per day are being shipped.

I think I have scolded enough about Tomichi, so will leave it with the hope, that when it is my lot to revisit it, that the claim owners, instead of waiting for some one to buy undeveloped properties, will have gone to work and proved in fact that my judgment is right regarding the real wealth of their own bodies.

Sargent's is the shipping point on the Denver & Rio Grande Railroad for this country, and wishing to see the

grade, I rode for about fourteen miles, down a good road, very even grade, down hill, to that place. After dinner, between Sargent's and Parlin's, I was caught in the worst storm of sleet I ever was out in, it came up so sudden along the river bottom that I could not get time to reach shelter, and was drenched through in a moment almost. I stopped all night at Parlin's and rode into Gunnison City before breakfast, the morning of October 27, 1882.

I had traveled many miles since I had left; seen very much that is good now, and more that will be better when developed. Much as I had seen, I could not help but feel that hard as I had worked, I could not begin to do justice to the country, without coming again and giving it more time.

Having a few days to spare I made two trips through part of the granite belt near Gunnison City. I did not find anything new, but was more strongly convinced than ever, that this section has not been properly prospected.

I thought I had got through, but just as I was ready to leave, I received word, that just beyond Sargent's were some formations which I needed to see to complete my Summer's work. Not wishing to leave anything undone that I could possibly accomplish this year, I took the train for Sargents on November 6th. On my arrival there I could not get a horse at all, nor could I learn anything of the surroundings from the people of the town apparently. I got rather desperate, and on the morning of the 7th I started for a walk up Agate Creek, a new and apparently undisturbed part of the country, as the trail was almost invisible and every few hundred feet was fresh beaver dams. The ascent is quite gradual and how many miles I walked I do not know; but sundown found me on top of the Continental Divide, rapidly feeling chilled as the elevation was high and the time of the year November. I had come most of the way through a country of red granite, entirely baren

and worthless, with not a sign of a cabin or camp anywhere. It was impossible to go back, and not the most cheerfull prospect to camp where I was. It took about two minutes to decide that I could not be worse off by going on, so down the east slope of the range I went, through a mile of snow, over my boot tops. To my delight, in the bottom of the gulch, I found a wagon road, instead of going down the gulch it struck me I might find shelter the quickest by going up, as it could not be far to its head and the end of the road, the evening also had got to be very dark. Less than half a mile brought me to a deserted saw-mill camp, with a fair cabin, a chimney and plenty of firewood lying around; a few minutes more and I had a roaring fire built in the fire-place, with myself stretched out on some boxes in front of it, as comfortable and contented as if I really knew where I was, which I did not. Pretty well tired out with the days tramp I was soon dozing, and then suddenly awakened to the fact, that the cabin had another tenant besides myself; the biggest, fattest, and sauciest mountain rat that I ever beheld. That blessed rat had an insane idea that he must try his teeth on my boots, well, he just kept me up all night. I had a good look at the great comet of 1882 between four and five o'clock of the morning of November 8th anyhow, then as it was light enough to see the road plainly I started down it, perfectly confident that a wagon road in this country would lead to—some where—between its ends, and as I was starting from the upper and worst end I was satisfied I was not passing or leaving any place of note behind me.

A ten-mile walk brought me to Maysville in the Arkansas valley, where I learned that I had come down Foise's gulch. I went to bed getting up in time to take the train for Salida.

On the morning of the 9th I got off the train at Marshall Pass, with my mind fully made up to see what kind

of rocks the railroad cut through between the summit of the range and Sargent's.

I found tertiary and cretaceous rocks, recent lavas, obsidian, porphyry and trachyte, as well as metamorphic rocks and granite. I found some indications of ore and veins, and I am certain I found the longest eighteen miles in Gunnison County, when I reached Sargent's in the afternoon with forty pounds of rocks in my sacks.

The next morning I returned to Gunnison and in a few days more to Denver.

Here ends the narrative of five months geological work, with what success in knowledge gained and given I leave my readers to judge, I merely have the feeling that I have tried.

CHAPTER XVII.

“Misled” Capitalists—Soft and Hard Coal Found in
 Gunnison—Definition of “Anthracite”—“What
 Is It?”—A Revelation—Beautiful Building
 Stone—A Little Local Reasoning—
 Five Days’ Search for an
 Illusion—Data—Test
 From Smith
 Bank.

A PENNSYLVANIA EXPERT DISCUSSES THE GUNNISON COAL
 BEDS.

To the Editor of the Times:

SIR:—My attention has been drawn to an article headed “Cretaceous or Carboniferous” and referring to the question of the occurrence of anthracite coal in Colorado, that appeared in your issue of Thursday evening last, 9th inst.

The article alluded to gave the substance of a conversation that took place between two geologists, and a capitalist who made an investment in lands believed to contain anthracite coal, situated some twenty miles northwest of Gunnison City. The geologists were distinctly represented as agreeing in the opinion that there was no anthracite in Colorado; the hard coal of the Gunnison country not being anthracite, because it was not of the same geological age as that of the Pennsylvania coal measures; while the capitalist was spoken of as having been “misled,” rather as though he had made a serious, if not costly blunder.

The question involved is one that will sooner or later be of interest to the people of Colorado in general, and there is in several ways enough room for misapprehending the force of statements, such as those cited, to render the truth or its further elucidation desirable. Moreover, if the details

pass without comment, they will convey a wrong impression and may possibly work injury in quarters where considerable interest in lands of like character are held, such, for instance, as Philadelphia, and I understand, Pittsburgh. I, therefore, beg to offer some particulars touching the hard coal of Colorado, and shall be glad to profit by the experience of others if any be incorrect.

There are certainly two kinds of coal found in Gunnison region, namely: bituminous or soft coal and the hard coal, commonly called anthracite. A statement has been published to the effect that there exists a large deposit of coal specified as the semi-bituminous. Some details were given, but very little seems to be known about it and no samples are obtainable that I am aware of.

With respect to the first of the two sorts undoubtedly existing, no one has apparently thought for an instant of questioning the propriety of its familiar name. It is called "bituminous coal" because it is "bituminous"—or containing bitumen. A name more accurate in its designation could hardly be devised or applied; indeed any other, even more convenient or appropriate could not now come into use. Bituminous coal is so called on the one account wherever found, those giving and using that name are little likely to confound it with other descriptions of coal, and seldom if ever, think of the geological epoch during which it was formed.

As regards the the hard coal of the Gunnison country, on somewhat similar grounds, I demand that it receive without question its just and proper title, by which it may always be known and distinguished, namely, anthracite.

I am disposed to doubt that the geologists, already spoken of, meant to convey the idea that, because the coal was not, geologically, of the same age as the anthracite of Pennsylvania, it was not anthracite at all. If so I submit that their distinction has been drawn from an abstract rather

than an economic or practical standpoint, which later, I hold, should have been the one to determine the question, being much the more important in its relations thereto. In this connection it might have been instructive to have touched upon the geological age or ages of the hard coals recognized as anthracites that exist, though to a limited extent outside of Pennsylvania; notably, in Rhode Island, and in several countries in Europe: Wales, France, Germany and Russia. The name anthracite, indeed, first used to designate a peculiar form of mineral coal by the German mineralogist, Karsten, about the beginning of the present century, was doubtless originally bestowed upon a sample from a European deposit. It was given as a mineralogical necessity to a coal that has been characterized by Dana, substantially, as follows: "A hard, compact variety of mineral coal of high lustre, consisting largely of carbon, containing but little bitumen, and remarkably free from sulphur." There is not, however, in this definition the slightest requirement that the coal must belong to any particular geological epoch.

Without presuming in any way to dispute the assignment of the Gunnison hard coal by experienced geologists to any age, arrived at as a result of their investigation, it would be difficult to say why this coal should not be called anthracite if it present the distinctive characteristics comprised in the definition thereof. That it does so can be readily shown.

It is anthracite in external character. Being desirous as a Pennsylvanian of satisfying myself concerning the question of Colorado anthracite. I, last September, visited Crested Butte, in the Gunnison region, where both the soft and hard coals occur in close proximity, though not together, so far as explored; the soft coal out-cropping along the face of the hill that forms the south side of the narrow gulch of Coal Creek, while the hard coal is found but a

short distance beyond the mouth of the gulch to the north. In company with two Pennsylvania coal operators of many years' experience, I examined the hard-coal veins at the several different points where development has been done. We found the coal hard, dense, compact and lustrous; not to be distinguished from Pennsylvania coal. The question of its being other than anthracite coal never presented itself and was never raised. The extensive acquaintance of the others amongst Pennsylvania coals led to their concluding that it corresponded nearest in physical characteristics to what we know as Buck Mountain coal. All the coal in the veins is not of the same hardness, some portions are harder than others, but the difference is scarcely greater than what might exist in other hard coal veins. The question is only relative, and one cannot justly say it is softer than Pennsylvania anthracite, since this, as is well known, is also variable. It would not, I judge, be difficult to select the counterparts of the Colorado coal as to differing degrees of hardness amongst those of Pennsylvania.

This coal is anthracite from its combustion. It shows the usual incandescence with retention of form. Little if any flame is seen after thorough ignition. It develops an intense heat, "lasts" a long time, and is a slow-burning, red-ash coal.

It is anthracite from its specific gravity. This is Pennsylvania coals varies from 1.3 to 1.7, giving an average of 1.5. The figures I have determined from four samples of the hard coal from Crested Butte vary from 1.4 to 1.5, with an average of 1.4.

It is anthracite from its composition. The rough variations in the constituents of Pennsylvania anthracites, as determined by analyses in the laboratory of the State Geological Survey, are as follows:

Water.....	2 to 4 per cent.
Volatile matter.....	4 to 6 per cent.
Fixed carbon.....	80 to 90 per cent.
Ash.....	4 to 10 per cent.
Sulphur.....	1.4 to 1.5 per cent.

I subjoin the composition of a hard coal from Crested

Butte :

Water.....	0.73 per cent.
Volatile matter.....	5.63 per cent.
Fixed carbon.....	87.83 per cent.
Ash.....	5.81 per cent.

100.00

The deduction as to the value of the above may easily be drawn.

I understand that hard coal has been discovered elsewhere in the Gunnison, of greater thickness than at Crested Butte, and it is claimed, containing ninety-two per cent. of fixed carbon. Of this I have not had an opportunity of examining the full analysis.

If, now, I have not shown the Gunnison hard coal to be anthracite, I feel like asking, after the manner of the capitalists already cited, "What is it?"

I contend that it is anthracite, but whether it really be so, or whether the capitalists have to supply it with a new name such as "anthracoid"—meaning "like anthracite," there is this to be said: there is no cause for discouragement on this score; the coal is excellent and when it is once mined and marketed at a fair price consumers will care but little whether it is "cretaceous or carboniferous."

Yours respectfully,

CHARLES HENRY BAKER,

Mining Engineer.

Denver, November 15, 1881.—*Denver Times*.

The foregoing appeared in the *Denver Times*, and afterwards in the *Gunnison News-Democrat*.

The following is my reading of these coals, and may

be taken as a reply to the query regarding the tertiary coal measures of Gunnison County :

Thinking it might help to settle the question, as well as give some additional information of possible practical value; this being the result of personal observation during a close examination lasting nearly five months, spent in and around these coal measures, with a view to determine their age, structure, and, in a measure, their commercial value as seen locally, and in comparison with data obtained from other sections.

The first five years of my geological work being among the coal measures of Missouri and Kansas, I have always been much interested in what had been brought to me in the way of specimens from the Gunnison country coals. For two years these specimens had come, the parties having the same claiming the product to be anthracite. This I disputed, as no one could inform me of any change in the connecting rocks that showed an opportunity for a change in the coal, by metamorphism, from a bituminous coal to an anthracite. In fact, I considered (without tests) that the appearance of the specimens were, in gravity, fracture, and luster, against such a result. The coals appeared more like the Albertites of Nova Scotia, or a coal highly charged with bitumen. On the other hand, the chemists' analyses shown me, gave such high results in fixed carbon that it must be rated as an anthracite; and if the latter, the rocks accompanying the coal-seam must show a corresponding change. As stated, of this none could tell me, and, as a geologist, I must confirm what the chemist had shown, or find out the reason why.

The geological structure of this coal measure formation, as seen by myself in the Crested Butte and Ohio Creek basins, was a revelation, as nothing like it is known or described in any works that I have; many things appeared to be reversed, and not at all analogous to other

known localities where coals occur. So great was this difference that I must give the facts as seen by an ordinary observer, and then try correctly to describe the geological structure, adding thereto a description of the characteristics of other sections, that the difference may be realized.

Take the first opening back of Crested Butte town, and to my amazement the coal lay upon shale, with a solid sandstone roof; and for 1,500 feet thick, as these measures appear to be, the rock formation is shale, coal and sandstone; no limestone belongs to this series, and nowhere does any animal life appear to have existed in the waters that deposited the sediments making the present existing sandstones and shales. All other coal measures known have most abundant remains of shell-fish in the limestones, sandstones, and shales of their respective ages.

The only fossils are the impressions of leaves of land plants and trees, that floated out to sea, sank, and left a record in the sands, saying here was a tropical climate, as most beautiful palm-leave impressions are obtained in one horizon, as well as many other leaves grown in a like latitude or climate, whose names I do not know.

The sandstone itself is a marvel, in places many feet thick, and repeated just the same many times in different strata; as, in looking for a cause that would account for the absence of life in these waters, I found the sandstone was not the *detritus* from the wearing away of other rocks, but was a precipitation of particles of quartz from a hot sea carrying an excess of silica in solution, cemented by a small amount of material that was produced from dissolved feldspar; not a rounded pebble in the whole series, but even-grained and homogeneous throughout.

I examined 100 square miles of these measures, and in the midst of it all found 2,000 acres of anthracite coal, the finest of its kind known on the continent, a four-foot vein,

giving from 90 to 94½ per cent. of fixed carbon, and no iron or sulphur in an appreciable quantity.

To finish with, 1,000 feet of conglomerate had at one time been deposited over the whole of this, and in another locality recent lavas were found overlying these tertiary sandstones.

If the above, which can be seen by any one, was not a geological problem, I have never met one. To solve it, I had to find the rocks of the next oldest age, which proved to be cretaceous, large shale beds of this age existing partly metamorphosed to a slate, and containing the characteristic fossil—*Inoceramus*—of the cretaceous seas.

The closing of this age gave me the key to very much, as locally it is marked by one of the most stupendous eruptions of volcanic paste that ever was known, covering hundreds of square miles on a cretaceous sea-bottom, not only flowing over these muds, where lived the *Inoceramus*, but also elevated in enormous masses, which now show as mountain ranges, as well as single mountains or cones. This volcanic mass is now geologically identified as granite porphyry, its constituents being silica, horn-blende, feldspar, a small amount of mica, and occasionally a small crystal of sanidine. The feldspar separated into beautiful crystals, with perfect sides and terminations, some of them of large size, held most firmly by the silica which makes the bulk of the paste. So much harder is this inclosing paste that it was difficult to get good specimens of the crystals, the latter decomposing more readily, and leaving perfect casts in the rock.

This granite porphyry would make the most beautiful building stone, as it is more easily quarried than Maine granite, more readily dressed, is just as durable, will take as high a polish, and when finished is as beautiful as any marble known, has no mineral constituents to oxidize and stain, and is in inexhaustible quantities. It comprises such

mountains as Crested Buttes, Gothic, Carbon, Edgely, Beckwith and Marcellina, as well as the ranges known as Ragged Mountains, the Anthracite range, and Wheatstone group. Near to part of these now run two railroads, and in time along these lines will be mammoth quarries; for here is a better rock to send East than the East can possibly send west.

The next move of nature in this locality was to elevate these submarine mountains above sea-level, so that shallow marshy seas were at their bases. The climate was at this sea-level I think, more tropical than any thing that we are acquainted with at the present time; as not only was the latitude such as to have hot seasons, but, in addition, towering up thousands of feet in every direction, were these mountains of volcanic material, giving off large volumes of heat by radiation: large masses of volcanic rock cool slowly in the atmosphere. In the gorges and open shallow seas of this tertiary age, at the feet of these mountains, and among all of this warmth—and very great moisture there must have been in the atmosphere, too—commenced the growth of the plants that now make these tertiary coals. How long time is, under such circumstances, as we reckon it, we can have no data; but sufficient was the period of rest here, for these plant-growths to accumulate several feet thick.

Here, I want to do a little local reasoning, that in principle may apply to other eruptive localities. To begin with, this eruptive matter must have been the product of internal heat below the earth's surface; the overlying crust must have been proportionately strong to hold such a vast quantity confined, with its cumulative force of steam and gas; when this power had accumulated sufficiently to exert itself, the eruptive power was in ratio to the results produced, which again was in proportion to thickness or resistance of the overlying earth-crust; after the eruption, there

would be an internal cavity approximating in size to the cubic contents of the mass recently brought to the surface; the original surface rocks would have the tonnage to support represented by the mass of eruptive material; this weight on the underlying shell then became to a greater or less extent plastic, and, without internal support, would cause a local sinking at varying periods, which periods of subsidence were represented by changes in the more recent sediments which were afterward deposited on the new floor or sea-bottom; and each and every one of such changes of sea depths can be counted by the variations in the newer strata of rocks.

Noting the above reasoning, in these coal basins, we find after a time a subsidence, and on top of the coal plants flowed a greater depth of water. The mountains were still hot, the exposed surfaces somewhat decomposed, this influx of water was heated to a great degree, and took into solution silica, which coming in contact with the organic matter in the then sea bottom, was precipitated, and also by the gradual cooling of the waters.

Here this section for a time was stationary, and the sands gradually filled with these watery depths until another shallow sea was repeated, and a subsidence followed which washed all of the loose movable soil of the adjoining lands and islands into the deep sea. This material made the mud deposit—shales now—which follows the sandstone. On these muds, in shallow water, the growth of the coal plants again commenced, to be followed in repetition by what has already been shown; and this was repeated six different times, or eighteen different subsidences and periods of rest are now shown to have occurred here locally; perhaps more, if we could get at the deepest part of any one of these basins. The strata built up, as near as I could ascertain, aggregates 1,500 feet in thickness.

Then followed a greater subsidence at once than at

any single time previous; a wider area of territory was acted upon by deeper waters; and instead of sandstones, resulting from precipitation, we have 1,000 feet of conglomerate, which covered all of the named mountains of granite porphyry.

This tertiary age was closed by the eruption of the lava showing on the dividing ridge between Ohio Creek and East River near Howville or Jack's Cabin. Subsequent erosion shows this lava on top of the tertiary sandstones, and subsequent erosion has worn down these sedimentary rocks deposited in the old mountain gorges between peaks and ranges of granite porphyry, laying clear the structure from the latest strata to where it began, and all to be seen and reasoned out as I have shown.

Now for the anthracite. I spent two days on Anthracite range, camping out to get at the following: Standing on the top of this range, it could be seen that, at the time of the recent or lava eruption, a deep gorge or crevice had opened from the eruptive point through between Wheatstone group and Mount Carbon. The opening came against the end of the Anthracite range, with the effect of setting or splitting off a single mountain mass by itself. This crevice, evidently, was also filled with eruptive matter, not coming to the surface, but exerting force and pressure sufficiently to slowly crowd this single mountain northward, which in its turn pressed against the coal measure strata built up at its feet and against its sides with such force that these originally horizontal sedimentary rocks were raised to an angle of 21° . The heat and pressure generated by this rock movement metamorphosed a coal-bed under 2,000 acres from a bituminous coal to a four-foot vein of the finest anthracite that is now known. Here geology and chemistry agree, and at this point, I think, Mr. Charles Henry Baker, M. E., is answered that it is anthracite.

The eruption of this lava raised the tertiary beds so that all of the strata dip away from the lava outcrop, $8\frac{1}{3}$ feet in each 100 feet; although in the Ohio Creek basin, I think, from what I saw, that the dip gradually increases as the lava mesa is approached. The sedimentary rocks broke in short cross-sections; along these breaks, lines of erosion now exist, wearing the surface into numerous gullies, exposing the coal-seams and thus making opportunities for original discoveries.

In the Ohio Creek basin, the greatest development is in the South Park coal-seam, opened under the superintendence of Mr. William Housley. The work is laid out on the English or long-wall system, and certainly showed the best work and most economical result of any of the developments which I examined. In this basin, another vein, the Richardson, has been opened on the Augusta and Owens claims, as well as on many others.

A section of these coal measures in the Crested Butte basin, where they are principally worked, would approximate as follows:

No. 1.	300 feet from top of hill is.....	1 foot of coal.
No. 2.	80 feet below this is.....	3 feet of coal.
No. 3.	65 feet below this is.....	4 feet of coal.
No. 4.	185 feet below this is.....	6 feet of coal.
No. 5.	78 feet below this is.....	10 feet of coal.
No. 6.	To this add in the Ohio Creek basin 200 feet below is.....	7 feet of coal.

Seam No. 1 is practically worthless.

Seam No. 2 is that opened and known as the Howard F. Smith bank, up Slate River.

Seam No. 3 is opened on the Smith & Jefferson claim, on the Weaver property, and one place between the anthracite coal near Irwin, on Anthracite range, is in this horizon.

Seam No. 4 is opened by the Colorado Coal and Iron Company, and in Baxter's gulch. In the Ohio Creek basin, No. 4 is represented by the Richardson, Augusta, Kubeler and Owens openings.

No. 5 is the coking coal vein now worked in the Crested Butte basin, by the Colorado Coal and Iron Company.

No. 6 is only known in the Ohio Creek basin and in the South Park Company's openings.

The eruption of the lava caused the fissuring of these tertiary rocks, so that now we have what has hitherto been unknown, namely, silver veins containing rich ruby and native silver ores, passing through coal measures. Where these veins break through, the coal-seams are liable to be broken and faulted; and in immediate vicinity to the fissure-vein, the coal will contain more or less iron and sulphur; at the same time, fragments of the coal will be found in the gangue-rock of the crevice.

Having some remarkable analyses of fixed carbon shown me from an opening up Slate River, three miles beyond Crested Butte, I went especially to examine the openings on the property. This vein would be the No. 2 of the series. The coal originally outcropped in a small gulch eroded into the side of the ridge rising from Slate River, and opposite to the entrance to O-be-Joyful basin.

The coal was followed in for nearly 200 feet, most of it being good merchantable coal, some of it having fixed carbon enough to be rated as an anthracite, and showing remarkably well in the face for this No. 2 vein. Numerous cracks or faults occur in the roof of sandstone, now making mud seams; near these, the coal was broken and worthless.

A new opening has been made into the hill from the head of the gulch, now nearly 300 feet in. On one side of this opening the coal is constant; on the other, a fissure-vein filled with eighteen inches of calc-spar, coming from the direction of O-be-Joyful gulch. This will certainly carry mineral with depth, and makes a connecting link through to the veins of Washington gulch, and absolutely

proves in fact what I had first advanced as a theory, that in localities the mineral veins would be found passing through coal-seams.

I followed these tertiary rocks across the head of Washington gulch, between Gothic and Baldy mountains, back of Bellevue mountain, down the valley of Rock Creek, over Mineral Point, Meadow and Arkansas mountains; and could see where they again came in below the lake near Rock Creek. Here erosion shows these old tertiary sea-bottoms to have been deep enough for the coal-seams to again appear, and report says there are much stronger veins than those in the particularly described basins.

The coal series of the Front range of Colorado, as well as in Middle and South Parks, belong to the cretaceous age. While I found cretaceous rocks in abundance on the west slope in the section examined this season, I did not find the coal of the same age, except in one locality, namely, Chicago Park, two miles from Pitkin. Here some holes have been sunk, disclosing the coal, but also showing, from evident and easily perceived causes, that it is worthless, being highly charged with iron and sulphur. The quantity here also must be very limited.

As to the character of plants that grew in these waters to make these coal-seams, there appears to be such a diversity of opinion among the highest authorities, that I do not think this character of metamorphism has been sufficiently proved as yet. This I would like to record, that from my personal work this season, the great difference between ordinary bituminous coal, and that which is called the coking coal, would certainly seem to arise from a material difference in the original vegetation.

I spent five days at Jack's Cabin, examining the rocks in connection with the lava outcrop, principally, because I had been informed that large bodies of hematite iron ex-

isted here; in fact, one of the United States geological reports gives this locality as the place where the largest body of iron ever seen occurs. After five days' work, I could not find it, and came to the conclusion that the first examination was a hasty one, and the conclusion jumped to that this black lava was hematite iron, when, as a matter of fact, it does not contain ten per cent. of iron.

I thoroughly examined the eroded basins between two lava mesas, hoping to find evidence of the coal-seams here, and that the heat and pressure from the over-lying eruptive rock would have changed such coal to an anthracite, but I could not find a particle. At present, I feel, from the showing, that the basin is not eroded to great enough depth to catch the coal-seams. On the other hand, there is a possibility, for all that now shows, that on this edge of the coal basin the underlying rocks rose, and only allowed the upper coal measure strata of sandstones and shales to be deposited over the older rocks, and the coal-seams do not exist.

I note the above from the fact, that, farther up on the Slate River, this same thing has occurred, from about the entrance to O-be-Joyful basin. The cretaceous shales appear by the roadside, and above them is the overflow of granite porphyry, overlain in turn by the strata of tertiary rocks, but only having in places the upper veins of coal Nos. 1 and 2, while the two seams worked by the Colorado Coal and Iron Company are entirely wanting. This occurrence is repeated up Coal Creek, a short distance from the Colorado Coal and Iron Company's openings; a break occurs across the hill between Coal Creek and Baxter's gulch, which, I believe, will mark the end of the two lower veins of this basin westward.

Such results as are set forth in the above paragraphs show how limited in the real coal area of the Crested Butte basin, while on the Ohio Creek side, such things do not ap-

pear to have occurred, which makes the area of this latter basin very much greater for a possible product of merchantable coal.

In speaking of the geology of coal sections, Dr. J. S. Newberry says "that many of the coal-seams of Ohio have been worked into, and exposed the following phenomena to view :

"1. A fire-clay below each seam, permeated with roots and rootlets of *stigmaria*.

"2. A coal-seam having a maximum thickness of six feet in the bottom of the basin, thinning out to feather edges.

"3. The coal on the margin of the basins is sometimes thirty or forty feet above its place in the the bottom.

"4. An average of two one half per cent. of ash.

"5. A roof composed of argillaceous shale, of which the lower layers are crowded with impressions of plants."

The above might be used for a general description of all bituminous coal fields of the carboniferous age.

The field I examined differs from No. 1, in that there is no appreciable amount of fire-clay, and argillaceous shales make the floor; from No. 2 in that in one place I found the seam of coal full size, abutting directly against granite porphyry, although, when the field is fully explored, there may be localities thinning out to feather edges, the same as in Ohio.

No. 3 might be found to differ locally in all coal basins. Of No. 4 the same might be said.

I think these tertiary coals average more than two and one half per cent of ash.

They differ from No. 5 in that the roof is sandstone, and the shale occurs below the coal.

A recent examination of the cretaceous coal at Golden, Colorado, shows veins varying from six to sixteen feet thick, average nine feet, standing nearly vertical, a

slight dip to the west, with a *roof of fire-clay*, affording excellent material for the manufacture of fire-brick and terracotta.

Concerning the economic values of the tertiary coals, I obtained the following data. Tests were from the Smith bank:

Moisture at 105 degrees.....	1.16
Volatile matter of red heat	4.70
Fixed carbon.....	90.20
Ash	3.94

Specific gravity at 60° Fahrenheit 1.419, a cubic foot of coal weighing eighty-eight pounds. Of five samples:

Moisture and volatile matter was.....	7.346
Fixed carbon.....	85.062
Ash	7.592

Other tests gave the lowest fixed carbon at seventy-seven per cent. Average amount of sulphur is 0.403 from three separate veins.

In calorific power, the maximum amount of carbon is 80.80.

Pennsylvania anthracite gives.....	77.88
Colorado " "	74.08
Canon City, Colorado, cretaceous coal.....	69.61
Wyoming cretaceous coal.....	63.74
Weber Canon, Utah coals.....	57.57
California coals	55.26

The above is the statement made by Charles P. Williams, chemist, Philadelphia, Pa.

Had the anthracite from the Anthracite range section been used for a comparison of calorific power, I am confident the record would have equaled the best Pennsylvania anthracite, as this coal is constant in fixed carbon from ninety to ninety-four and one half per cent.

From another source I learn that the amount of illuminating gas from these tertiary coals is seven one quarter cubic feet per pound of coal, or 14,500 cubic feet per ton of 2,000 pounds, not equaled anywhere as far as now known, except perhaps by the Albertites of Nova Scotia.

Of the coking coal seam, the following was obtained from Mr. James K. Robinson, superintendent of the Colorado Coal and Iron Company's mine. Sample came from 1,200 feet in, and was the latest test up to October 6, 1882

Water.....	.72
Volatile matter.....	23.24
Fixed carbon.....	71.91
Ash.....	3.93

In comparison, Connellsville coal shows:

Moisture.....	1.260
Volatile matter.....	30.107
Fixed carbon.....	59.616
Ash.....	8.233
Sulphur.....	0.784

While tests from a coking coal in Kentucky ranged in

Volatile matter.....	30.060 to 37.160
Fixed carbon.....	54.740 to 62.100
Moisture.....	2.000 to 8.000
Ash.....	2.900 to 4.340
Sulphur.....	.494 to 1.475

Thus showing these tertiary coals far ahead in economic value.

The average value of bituminous coal at Golden, Colo., for two years has been \$3.30 per ton; cost of mining and hauling, \$2.57 per ton. In the East, this grade of coal is worth, on an average, \$1.22 per ton; cost of mining, \$0.88.

Connellsville coke at the ovens is worth \$1.75 per ton, and a protective freight tariff in favor of Colorado production of \$20 to \$45 per ton.

With the above named freights, Gunnison County ought to get a share of that business on a very profitable basis.

CHAPTER XVIII.

The Final Summing Up of the Work Done.

The following might be considered a general summing up of the geology and connecting mining interests of what I found in these five months' constant work, over an area of territory covering 3,000 square miles; through which I have daily traveled, examining its geological and mineral bearing sections. Walking and riding nearly 1,500 miles to thoroughly learn the same; and, I now realize that it has been a more complete examination than has ever been attempted before.

This district, examined, is bounded by the North Fork of Anthracite Creek, Treasury Mountain, Crystal basin, and below Sheep Mountain on the north, the head of Conundrum gulch, Teocalli and Italian mountains, heads of Spring Creek, Quartz Creek and Tomichi River on the east. The Granite belt south and southwest of Gunnison City, for forty miles, through from Pitkin to Cebolla on the south. The coal measures of Ohio Creek, the Anthracite range and Ruby mining districts on the west.

Of this 3,000 square miles I find nearly 2,000 of it would be embraced under the head of mineral lands; nearly 100 square miles as coal lands; the rest as ranch, grazing and timber lands, including some barren rocky districts in which nothing of practical utility has yet been discovered.

The geological structure would be found to be briefly as follows:

A belt of primitive or archæan granite extends from the Continental Divide on the head waters of Quartz Creek and Tomichi River, through southwest to White Earth River, a distance of over 55 miles, averaging ten miles in

width; is well fissured and evidently contains the basis of many fine gold mines, as well as large bodies of iron ore; the latter are shown more strongly at Cebolla, while the gold veins are most prospected in the neighborhood of Pitkin down to Ohio City, seven miles, and some near Tomichi, the best districts to my mind not being prospected and worked at all yet.

This same granite is encountered again in Swan basin, eight miles from Irwin, on the Anthracite Creek slope, it is also the dividing crest of Poverty gulch, showing twenty feet wide and half a mile in length, at over 12,000 feet elevation. It makes the underlying rock of Paradise and Carl Schurz, or Bear basins; it is the rock of Snow Mass mountains; from here continues almost in a direct line south, showing as the dividing range between Conundrum gulch and Gothic, or head of Copper Creek, continues down and along Taylor Park and River, and through to the Continental Divide at the head of Tomichi River, or place of beginning.

I am thus particular in describing these rocks, owing to their governing influence on the quantity and quality of the minerals that are found in connection with them.

Of sedimentary rocks I could not find those of the Devonian and Silurian ages at all, unless they are represented by some detached localities of small area, showing now thin bedded and metamorphosed to mica schists, etc.

The oldest sedimentary rocks to be identified, were the sandstones near Gunnison City, and a limestone with fossils a few miles up Brush Creek; these rocks are carboniferous.

This period was closed by the eruption of the red-feldspathic granites, which occur most abundantly on Cement and Brush Creeks. I also found some evidences of the same on Taylor River, Quartz Creek and the Tomichi. The closing of the carboniferous age on this

slope does not appear to have been attended with the same extensive eruption of red granite, as is evidenced on the eastern slope or Front range of the Rocky Mountain system.

The principal mineral veins of this period are marked as very wide, filled with a quartz porphyry gangue, partially mineralized with a very low grade ore, principally iron sulphides, and generally not of practical value, except where more recent veins break through this rock again, allowing a reconcentration of the mineral particles. Where this has occurred the ore appears to be exceptionally rich in the last formed veins.

Following the eruption of the red granite, came the building up of the cretaceous rocks, consisting of sandstones, limestones, and shales alternating. No coal occurs here with these rocks same as is shown in connection with those of the same age along the Front range, excepting a small and very limited era in Chicago Park, two miles from Pitkin, and which is now practically worthless, owing to subsequent changes, which have thorough charged it with iron and sulphur. This little spot is all of the cretaceous coal I have so far found on this slope. The closing of the cretaceous age in this described section, was marked by one of the most stupendous eruptions ever recorded, covering hundreds of square miles with one class of eruptive material, building up not only single mountains but mountain ranges, and one peak with this rock for its dome, is one of the highest in the State, viz: Monumental Mountain at the head of Tomichi River, and of nearly 14,000 feet elevation.

This rock is known as Granite porphyry, and is the material of such ranges as the Wheatstone group, Ragged mountains and the Anthracite range, also of single peaks, such as Crested Butte, Gothic, Carbon, Edgely, Beckwith and Marcellina. As has been noted before, I believe it to

be one of the finest building stones on the continent.

The heat and pressure (for this eruption occurred at great sea depths) generated during this age or Granite porphyry eruption, partially metamorphosed these cretaceous rocks, the sandstones to quartzites, the shales to slates, and the limestones towards a marble in some localities.

Now, geologically speaking, before we can have mineral sections, we must first have volcanic or eruptive centers, from which long, and generally parallel fissures extend through the earth's crust. The fissures principally follow one general course, and if carefully traced on, or by the surface evidences, will be found to lead from one eruptive point to another, and so on for many miles, especially through a mountainous and mineral bearing country.

These fissures and eruptive places also denote a mechanical fact, that they always occur along a line of greatest weakness in the earth's crust, and this deduction gives a common reason for the continuance of mineral belts in a general course.

These fissures are filled with mineral atoms, derived from the country rocks through which the crevices open, representing practically a concentration of atoms, taken up in solution from the neighboring country rock. The waters passing along these earth crust openings being mainly thermal, and of strong solvent powers. T. Sterry Hunt says the solvent powers of cold water are sufficient to take into solution any known mineral element, and in thermal waters this power is increased. Of this fact I obtained absolute proof in nature, in one locality finding iron pyrites, galena, zinc and quartz crystals, all being deposited to-day as a precipitant from a cold water stream.

Agassiz says, when referring to the possible ages of mountain chains, that the power required for the eruption of volcanic masses is in proportion to the thickness of earth crust to be broken through, that the results obtained are

in proportion to power used or required, consequently the largest eruptive masses and highest mountain ranges are of the latest ages. Now follow out this method as applied to mineral sections, and if my deductions are correct as stated, regarding the forming of mineral veins, as the resultant of the fissuring of the earth's crust by eruptive forces; then the amount and size of veins with their ore contents should be in proportion to the eruptive masses, produced at the commencement of the era or age, represented by the eruptive rock.

This section having locally the largest amount of this character of material known in any one locality, it would be reasonable to look for a proportionate amount of mineral and fissure vein products, and if absolute proof of the correctness of such reasoning is not found in this described section of Gunnison County, it never will be proved by the geology of any other section of the world.

Commence at the head of Slate River, cross over the divide to the head of Rock Creek, pass around Galena Mountain into Crystal basin at the foot of Treasury Mountain, and every few hundred feet there is vein after vein of ores, large and strong, carrying iron, zinc, galena and copper sulphides. These veins break through cretaceous slates, which character of country rock adds nothing to the value of the vein product, but rather allows a deterioration from the fact, that the slate is friable, breaks and crumbles into the fissures, mixes country rock with the vein material, thus enlarging the crevices, allows them to become irregular, and generally cursed by the prospector and miner. However, in this locality it is but small depth, comparatively speaking, to the underlying country rock, viz: primitive granite, and into which the veins must pass. Here, as noted elsewhere in this book, the ore will be found to be concentrated into fissures with good and true walls, also

an increase will be found in the quality, especially of the gold and copper product.

So great was the mineralizing action, especially in one of the basins named, that the rocks parted between layers of quartzite, slate and limestones allowing bands of ore to form in horizontal beds between the strata, as well as in the vertical fissures that are found breaking across the stratified rocks. These flat veins have a general inclination, or dip of 30° above a horizontal line, but at some depth will pass into the granite.

This basin, I believe to be the most wonderful mineral section now known. The principal base ores are iron, zinc, galena and copper sulphides, carrying a fair average value in gold and silver; the latter, where combined with antimonial galena, rises to a grade of several hundred ounces per ton. One vein, a flat one, can be traced from the point of Treasury Mountain, where it is opened fourteen feet solid in ore, round to the entrance of the basin, fully two and a half miles, and a continuous average ore body of at least ten feet solid of mineral.

From the principal mine opened, ore was shipped by burros eight miles, by wagon six miles, by rail to Denver at \$8.00 per ton freight, and then after deducting smelter charges and cost of mining paid the owners, \$45.00 per ton net in car load lots. I saw one car load of lead ore that was settled for at the rate of seventy-seven per cent. for the metallic lead, while a picked assay test gave eighty-six per cent. of the same metal in the ore, the highest grade galena now known. The copper sulphides give twelve to fifteen per cent. metallic copper.

From this single basin can be produced—it is only a question of the number of men put at work—more tons of ore per twenty-four hours than the whole Leadville district now produces,—nearly 1,500 tons per day—and of as fair an average grade in value.

On the other side of the basin is another large vein, across the surface of which, where I had the rocks in place, I broke mineralized rock for a space of 150 feet wide.

To this section and veins of this age may be added, Paradise basin, Baldy Mountain, part of Bellevue, Mineral Point, Meadow and Sheep mountains, all of them according to my reasoning, showing a good foundation for the belief that the ores will increase in quality, after certain depths are passed, except Sheep Mountain.

On this mountain the ores will be no better in quality for great depths, than the sulphides show at the top of the veins, from the fact that the cretaceous rocks show much greater strength here than elsewhere, it being nearly 3,000 feet down to Rock Creek from the mountain top, and all stratified rocks. This places the granite the practical source of supply, at this locality, to deep to act as a governing influence over the whole vein product.

However, the lower grade ores found here will probably increase in quantity with depth, if not in quality.

Coming back to this age of veins, we have on the headwaters of the Slate River, veins breaking through an older vein formation, viz: the quartz porphyry, here the zinc sulphides as a re-concentration, rise in value to over 500 ounces of silver per ton, the highest grade zinc I have met.

The next district of this age we find by passing from the head of Copper Creek to Conundrum gulch. Prospecting has only begun here and the real value of the section not proved.

Next in order is the head of Brush Creek, and over Pearl Pass to Ashcroft.

Between Pearl Pass and Ashcroft occurs the largest outcrop of ore I have ever seen, with but one exception.

The next section will be found geographically as the head of Cement Creek and Taylor River. Here prospecting

has only begun, but the veins and geological structure being the same as the Rock Creek country, many good things ought to be found, as well as large ore bodies.

After this came south of Italian Mountain to the head of Spring Creek.

The cretaceous limestones commence to show here, and make contact veins highly charged with galena sulphides.

The Doctor mine is the principal one opened, and with only the development of one season, has \$160,000 gross in sight. Next to this is the King lode claim, out of which I saw large masses of galena taken from an open cut. More of these ore bodies ought to be found near here and doubtless will be in the future.

This belt probably extends from the head of Spring Creek, across the Taylor River, through or near by Union Park, above the head of the lesser Ohio Creek, above Pitkin, crossing the heads of Quartz Creek, and showing an abundance of ore in the Silver Islet, Fairview, Way Up and Silent Friend properties, as well as many prospects on the same belt too numerous to mention.

At the head of the North Fork of Quartz Creek, many other veins pass through in the direction of Tin Cup. It is at the head of this creek that the Porcupine group of mines is situated, already described in another place. About six miles from Pitkin this great contact series of veins crosses the North Fork of Quartz Creek on to Prospect Mountain. Here the only mine opened is the Celestial, from which iron ore to be used as a flux, was being shipped to St. Elmo. Some very high gold assays were claimed from this mine, one showing thirteen oz. gold per ton.

From Prospect Mountain the contact I have been following appears to pass over to the east side of the Continental Divide, sweeping around by Hancock, and re-ap-

pearing again on the west slope at the head of Tomichi River and below Monumental and Clover mountains.

These mountains are capped with granite porphyry, here the eruptive rock broke up the line of possible contact. However, where it has come in again it has lost nothing in strength, as there is 6,000 feet opened that shows the third largest outcrops of mineral, and now the greatest possibilities of galena ores of any part of the belt. The North Star, Carbonate King, Iron Mask, Iron Duke, Iron King, and other claims in Galena guch, at White Pine are on this belt.

From this place I found the contact veins again crossed the range, some where above Agate Creek, on the west slope, re-appearing in the Arkansas valley near Maysville.

To this point is as far as I have traced the veins of the granite porphyry age of eruptive rock, but the granite on the west side of the Tomichi appears also to be fissured for five miles down stream. This I have called particular attention to, when describing this locality in a former chapter, and refer to it as a very rich gold and silver section, but not worked as it should be.

In giving a condensed statement of the mineral belt of this age, it would appear as follows: That it is continuous through from Snow Mass to White Pine, a distance in an air line of over 100 miles; that the veins vary in width from ten to 500 feet; that the belt is three to five miles in width; that the strongest veins originally had heavy bodies of iron as the surface ores followed by zinc, galena and possibly copper as depth is gained in mining; that subsequent surface erosion has cut off most of the iron, but the galena can be found with the limestone, more or less constant the whole distance, and where the whole of the limestone is eroded, I find the veins constant in granite, a larger percentage of copper as base, and the ores higher grade in gold and silver; that in a geological sense the

veins and ore products are in proportion to the granite porphyry eruption, and a direct result of the same geological age, viz: the closing of the cretaceous period.

Further, that this belt of veins and ores of the same age, ought to continue on the other side of the nucleus described, crossing over to and continuing in connection with the Uncompahgre range as it does with the Elk Mountain system, varying only in quality of ores as the country rocks may change.

The quieting down of this locality, after the great and radical changes just described, allowed the commencement of a new geological period, viz: the tertiary which proceeded to build up locally as I have attempted to illustrate, with its coal formations, in the preceding chapter, so that with reference to the rock formation of this latest age, I may now pass on to the time of their close. This is a repetition of the two preceding ages, inasmuch we find that the carboniferous period was closed by an eruption of red, feldspathic granite, the cretaceous age by a local eruption of granite porphyry, and now the tertiary we find was terminated by the eruption of lava, the principal locality showing, is on the dividing ridge of Ohio Creek and East River, a few miles from Gunnison City.

This time the eruptive power was not required to rend the overlying rocks to the same extent as noted in the previous ages. Consequently the eruptive material produced was not so great in quantity, nor the accompanying fissuring of the rocks larger in proportion than would be naturally looked for in a comparative ratio to the other results produced.

The eruptive rock of this age was a black vesicular lava, proving an eruption into the atmosphere by the large number of air-cells or blebs in the material. This occurred just south of the Wheatstone group, and flowed over the tertiary formation some square miles. Subsequent erosion

cut the mass in two, leaving at the present time, two flat or table-like formations several feet thick, capping a dividing ridge between the two named streams.

When the lava eruption occurred, a proportionate amount of fissures opened, proving again a mechanical fact in relation to veins, which is, that they always open through lines of weakness in the earth's crust. For these latest fissures followed the lines of the old gorges between mountains of granite porphyry, then filled with tertiary strata, instead of following possible direct lines, and fissuring such mountains, I did not find a single vein of mineral passing through the large mountain masses of granite porphyry. While on the other hand the gorges between these mountains were full of them.

As these veins are of the latest age, so they are in proposition to the eruption, that they are the direct consequence of, and as compared to the veins of the immediately preceding age, are quite limited in extent. But they carry the richest ores of the whole section, as proved by the developments at Irwin, the product being ruby silver with native metal also, and very high grade zinc and galena sulphides. It is only in connection with these described rocks and age of veins, that I found ruby silver ores.

The opening of these fissures started the present lines of erosion and drainage, so that now the country presents the appearance of a number of mineral basins eroded down into the coal measures, with granite porphyry peaks and croppings occurring in every direction around them.

A beautiful illustration occurs in these districts of the direct influence of country rock through which the fissures opened, over the character of the vein product. I could start at the head of one of these basins, where the vein material outcrops in the conglomerate, and the ore would be low grade, principally zinc, iron and galena sulphides, with only a value of \$15.00 to \$20.00 per ton in silver.

Follow the same vein down to where the conglomerate is removed by erosion, and the vein outcropped in the real coal measure sandstones, there ruby and native silver begins to appear with the named sulphides, but the gangue combining with the ores, is still silica. Follow the same vein down to where all of the coal measure strata has been eroded, and the vein outcrops in granite porphyry, here I find the same rich ores as ruby and native silver, silver glance, also high grade galena and zinc, but the gangue changes from quartz to calc-spar.

This is the first experience that miners had in Colorado of rich silver veins occurring through horizontal coal measure strata, and with such an anomaly to work in, it is not to be wondered at that mistakes have occurred, some of them expensive ones. But where I can get rich ruby and native silver ores outcropping at grass roots, with sulphides of iron, zinc and galena, as I have on many claims in the Ruby district, I am not afraid to bank on the future product of the section. These ores go down, and are in just as permanent true fissure veins, as those occurring in any other geological section known.

This section is bounded on the north by the North Fork of Anthracite Creek, on the west by the South Fork of the same, on the south by Coal Creek, and on the east by the Slate River.

It comprises such basins as Ruby district, Ruby gulch Justice Elk, Independence, Coon, Evans, Peeler, Redwell, Democrat, Hardscrabble and O-be-Joyful basins.

In Swan, Mineral and Kansas basins, Poverty gulch as well, and also the North Fork of Anthracite Creek, the ores change in accordance with the change in the country rock, while Iron and Silver basins do not show much to be counted upon for pay of any kind of ore whatever.

The head of Washington gulch, eight miles from Crested Butte, gives ores of the same character as the Ruby district, and I am certain the same belt extends further on, passing to the east of Bellevue Mountain, but not now developed enough to prove the value of the ore bodies.

On development some of the veins of this age will be found passing through coal seams of the tertiary period.

The foregoing represents as succinctly as possible a resume of what is the general characteristics in mineral wealth of this country, so that I have found in brief, that within a radius of seventy-five miles of Gunnison City, there are 2,000 square miles of mineral lands, with more ore per square mile than was ever seen before in the world to know it.

That the drainage of all but three points is towards a common center meeting at Gunnison; that the whole country is readily accessible, having two competing railroads, narrow gauge, with a prospect of a third and broad gauge road within three years; that branch lines have been or will be extended to both coal sections; that Gunnison County has expended this year (1882) \$100,000 in making good wagon roads from railroad points to all of the most developed mining camps.

That, although this country is barely three years old, work enough has been done to prove that these mineral sections are permanent and productive.

That Gunnison City is located in the centre of the largest mineral belt now known; with coal fuel the nearest by of the very best quality, and in quantity sufficient to smelt the ores produced.

That this season saw one of the most successful concentrating mills in the State, built in this part of the country, viz: at Elko on Rock Creek.

That, personally, I have not visited a single mining camp, but that is capable, in time, of furnishing forty to 1,000 tons per twenty-four hours, of concentrating ore for just such mills, and which are the practical mills for all mining districts.

That, at Gunnison City there is now a smelting furnace building by one of the most successful men, connected with ore reduction (lead ores) in the United States.

That, I have seen, personally, enough gold and silver districts, in this described territory, to produce more of those values per annum, after the next five years' development, than was the output of the whole State of Colorado in the year 1882.

That, I have seen lead ore enough, and indications of it sufficient to warrant the statement, that the product will in time compare favorably with the output of the State of Missouri.

That, I have examined more iron ores than is now known in either of the States of Pennsylvania or Missouri.

That, I have seen districts enough, with copper sulphides in their veins, to run a smelter plant on the Copper-Matte basis, ten times as large as the present works at Argo, Colo. (Hill's works).

Such works ought to be established at a central point like Gunnison City; that the gold ores of Ohio City, Pitkin, the Granite Belt and Tomichi, could meet the copper sulphides half way in transportation and be reduced with them.

That, within this territory I have found Tellurium ores.

That, I have been over more than eight square miles of territory containing nickel and cobalt—more than was ever seen before in paying quantities.

That, there is 350 square miles of gold territory, almost wholly unimproved, in which it may be possible to find Iridium, Palladium and Platinum.

That, I have found traces of tin, but have not proved its existence in paying quantities.

That, there is building stone of unsurpassed quality and inexhaustible quantity; that limestones, gypsum and marbles exist in large quantities.

That, I have found that rare mineral Uranium to exist in paying quantities.

That, while I did not find fire-clay at all, I found immense quantities of ordinary clay for building brick.

Last, but not least, the climate is unsurpassed, elevation not too great, nor winters too severe, but that work in the mines can be carried on the whole year through with a proper preparation, that the valleys are mild, well watered, and the finest stock country in Colorado.

What more I would ask can be wanted, to make a large and prosperous city at a central point in this described region, where all of the products of this unusually natural rich section, can meet on a down hill grade, at a common center to be handled, while the same place in turn will be the distributing center of this whole section for what is consumed.

Such are the present and prospecting advantages of Gunnison City, the commercial center of the future Bonanza County of Colorado, as seen by the writer.

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